SOIL SURVEY

Foard County

Texas

OUR SOIL ★ OUR STRENGTH

UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
In cooperation with
TEXAS AGRICULTURAL EXPERIMENT STATION

Series 1961, No. 14

Issued November 1964

HOW TO USE THE SOIL SURVEY REPORT

THIS SOIL SURVEY of Foard County will help farmers and ranchers in planning the kind of management that will protect their soils and provide good yields; assist engineers in selecting sites for roads, ponds, buildings, and other structures; and add to our knowledge of soils.

Use the index to map sheets to locate areas on the detailed soil map. The index is a small map of the county that shows what part of the county is represented on each sheet of the soil map. When the correct sheet of the soil map is found, it will be seen that boundaries of the soils are outlined and that each soil is identified by a symbol. All areas marked with the same symbol are the same kind of soil. Suppose, for example, an area has the symbol AbA. The legend for the detailed map shows that this symbol identifies Abilene clay loam, 0 to 1 percent slopes. This soil and all the others mapped in the county are described in the section "Descriptions of the Soils."

Farmers and ranchers and those who work with them can learn about the soils in the section "Descriptions of the Soils" and then turn to the section "Use and Management of the Soils." In this way they first identify the soils on their farms or ranches and then learn how these soils can be managed and what yields can be expected. The "Guide to Mapping Units" at the back of the report will simplify use of the map and report. This guide lists each soil and land type mapped in the county and the page where each is described. It also lists, for each soil and land type, the capability unit and range site and the page where each of these is described.

Engineers can refer to the section "Engineering Uses of the Soils." Tables in that section show soil characteristics that affect engineering.

Scientists and others who are interested can find information about how the soils formed and how they are classified in the section "Genesis, Morphology, and Classification of the Soils."

Students, teachers, and other users will find information about the soils and their management in various parts of the report, depending on their particular interest.

Newcomers in Foard County will be especially interested in the section "General Soil Map," which describes the broad patterns of soils. They may also wish to read the section "Additional Facts About the County," which describes the climate, physiography, relief, and drainage and gives some statistics on agriculture.

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Fieldwork for this survey was completed in 1961. Unless otherwise indicated, all statements in the report refer to conditions at that time.

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SOIL SURVEY OF FOARD COUNTY, TEXAS

BY WILLIAM M. KOOS AND MARVIN L. DIXON, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE IN COOPERATION WITH THE TEXAS AGRICULTURAL EXPERIMENT STATION

FOARD COUNTY is in north-central Texas (fig. 1). It has a total area of about 432,640 acres, or 676 square miles. Crowell, the county seat, is 79 miles northwest of Wichita Falls, which is in Wichita County, and 116 miles north of Abilene, which is in Taylor County. Crowell has a population of about 1,900; it serves a productive livestock, farming, and oil-producing area.

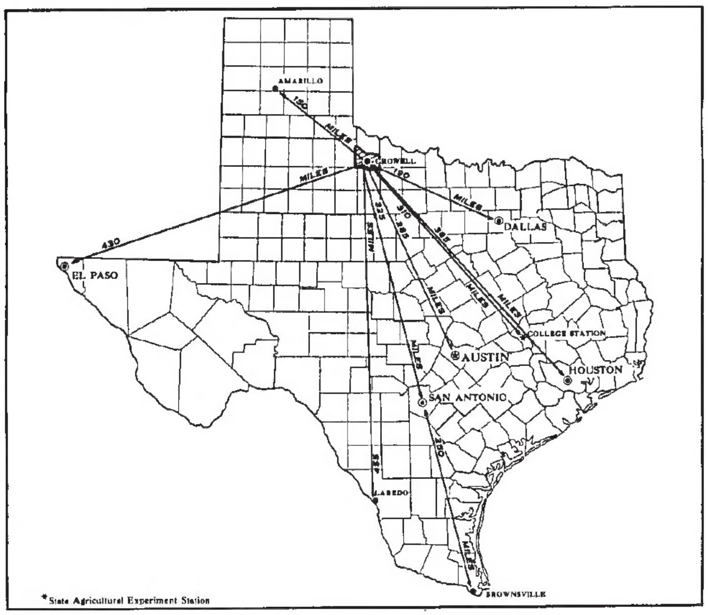

Figure 1.—Location of Foard County in Texas.

Approximately 55 percent of the county is cropland. Much of this is subject to both water and wind erosion. Like most other west Texas counties, Foard County has periods of drought and occasional years of adequate rainfall. During the dry years, satisfactory crops are produced only on the best soils. Wheat is the main cash crop.

Farmers and ranchers in the county organized the Lower Pease River Soil Conservation District in 1944. It includes all of Foard and Hardeman Counties. Through this district the farmers and ranchers receive technical assistance from the Soil Conservation Service in planning for the use and conservation of the soils on their farms and ranches. This soil survey was made as a part of that technical assistance.

How Soils Are Mapped and Classified

Soil scientists made this survey to learn what kinds of soils are in Foard County, where they are located, and how they can be used.

They went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. As they traveled over the county, they observed steepness, length, and shape of slopes; size and speed of streams; kinds of native plants or crops; kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. To use this report efficiently, it is necessary to know the kinds of groupings most used in a local soil classification.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Abilene and Miles, for example, are the names of two soil series in Foard County. All the soils in the United States having the same series name are essentially alike in those characteristics that go with their behavior in the natural, untouched landscape. Soils of one series can differ somewhat in texture of the surface soil and in slope, stoniness, or some other characteristic that affects use of the soils by man.

Many soil series contain soils that differ in texture of their surface layer. According to such differences in texture, separations called soil types are made. Within a series, all the soils having a surface layer of the same texture belong to one soil type. Miles fine sandy loam and Miles loamy fine sand are two soil types in the Miles series. The difference in texture of their surface layers is apparent from their names.

Some soil types vary so much in slope, degree of erosion, number and size of stones, or some other feature affecting their use, that practical suggestions about their management could not be made if they were shown on the soil

map as one unit. Such soil types are divided into phases. The name of a soil phase indicates a feature that affects management. For example, Miles fine sandy loam, 1 to 3 percent slopes, is one of several phases of Miles fine sandy loam, a soil type that ranges from nearly level to moderately sloping.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field borders, trees, and other details that greatly help in drawing boundaries accurately. The detailed soil map in the back of this report was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning management of farms and fields, a mapping unit is nearly equivalent to a soil type or a phase of a soil type. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil type or soil phase.

In preparing some detailed maps, the soil scientist has a problem of delineating areas where different kinds of soils are so intricately mixed, and occur in areas so small in size, that it is not practical to show them separately on the map. Therefore, they show this mixture of soils as one mapping unit and call it a soil complex. Ordinarily, a soil complex is named for the major kinds of soil in it, for example, La Casa-Ector complex. Also, on most soil maps, areas have to be shown that are so rocky, so shallow, or so frequently worked by wind and water that they scarcely can be called soils. These areas are shown on a soil map like other mapping units, but they are given descriptive names, such as Gravelly rough land or Loamy alluvial land, and are called land types rather than soils.

While a soil survey is in progress, samples of soil are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soils in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soils. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way that it is readily useful to different groups of readers, among them farmers, ranchers, managers of woodland, engineers, and homeowners. Grouping soils that are similar in suitability for each specified use is the method of organization commonly used in the soil survey reports. Based on the yield and practice tables and other data, the soil scientists set up trial groups and test them by further study and by consultation with farmers, agronomists, engineers, and others. Then the scientists adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

After a study of the soils in a locality and the way they are arranged, it is possible to make a general map that shows several main patterns of soils, called soil associations. Such a map is the general soil map in the back of this report. Each association, as a rule, contains a few major soils and several minor soils, in a pattern that is characteristic although not strictly uniform.

The soils within any one association are likely to differ from each other in some or in many properties; for example, slope, depth, stoniness, or natural drainage. Thus, the general map shows, not the kind of soil at any particular place, but patterns of soils, in each of which there are several different kinds of soils.

Each soil association is named for the major soil series in it, but, as already noted, soils of other series may also be present. The major soils of one soil association may also be present in another association, but in a different pattern.

The general map showing patterns of soils is useful to people who want a general idea of the soils, who want to compare different parts of the county, or who want to know the possible location of good-sized areas suitable for a certain kind of farming or other land use.

The general soil map of Foard County shows seven associations. Three are mainly hardland, two are sandy land, one is mixed, and one is rough land.

1. Abilene-Hollister association: nearly level hardland soils

This association is on a nearly level plain dissected by a few tributaries (fig. 2). The main part of it is a large, irregularly shaped area between the Pease and Wichita Rivers, in the eastern half of the county. About 20 percent of the county is in this association.

The soils of the two major series, Abilene and Hollister, are dark colored and deep. The surface layer and the upper part of the subsoil of the Abilene soils consist of crumbly clay loam. The surface layer of the Hollister soils, which are the less extensive, is clay loam. The subsoil is clay. When moist, it is more firm than the subsoil of the Abilene soils and less easily crushed.

Minor areas of the Tillman, Wichita, and Vernon soils make up about 10 percent of this association.

Most of the acreage is cultivated. Wheat is the main crop, but some cotton is grown. The soils are fertile, but lack of rainfall limits yields in most years. Crop residues and soil-improving crops reduce the amount of crusting and help to keep the surface layer friable.

2. Tillman-Vernon association: sloping hardland soils

This association consists of gently sloping soils on ridges and moderately sloping soils along drainageways throughout the southern and southwestern parts of the county (fig. 3). About 43 percent of the county is in this association.

The Tillman soils are deep and reddish brown and have a firm, but crumbly, surface layer. They have a clay subsoil that is very firm when moist. The Vernon soils

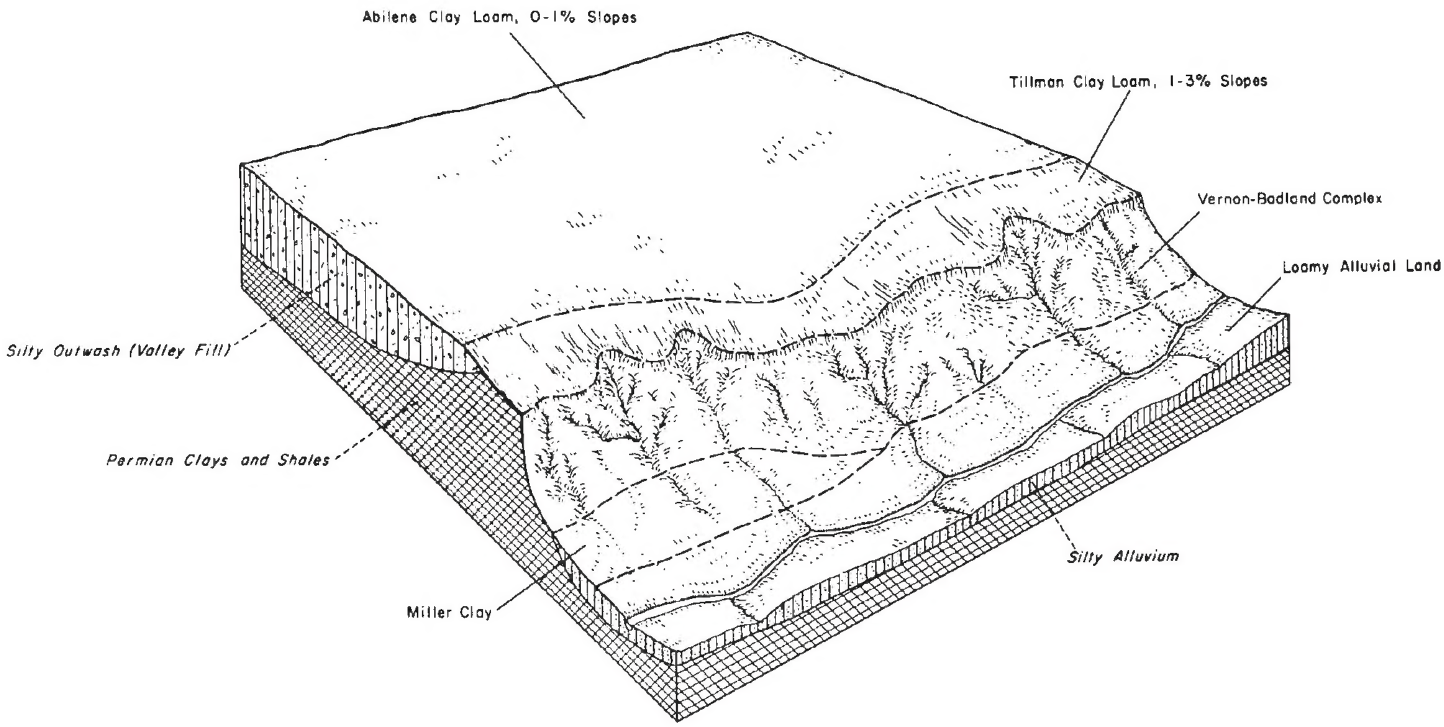

Figure 2.—Representative pattern of Abilene soils and some of the other soils in association 1.

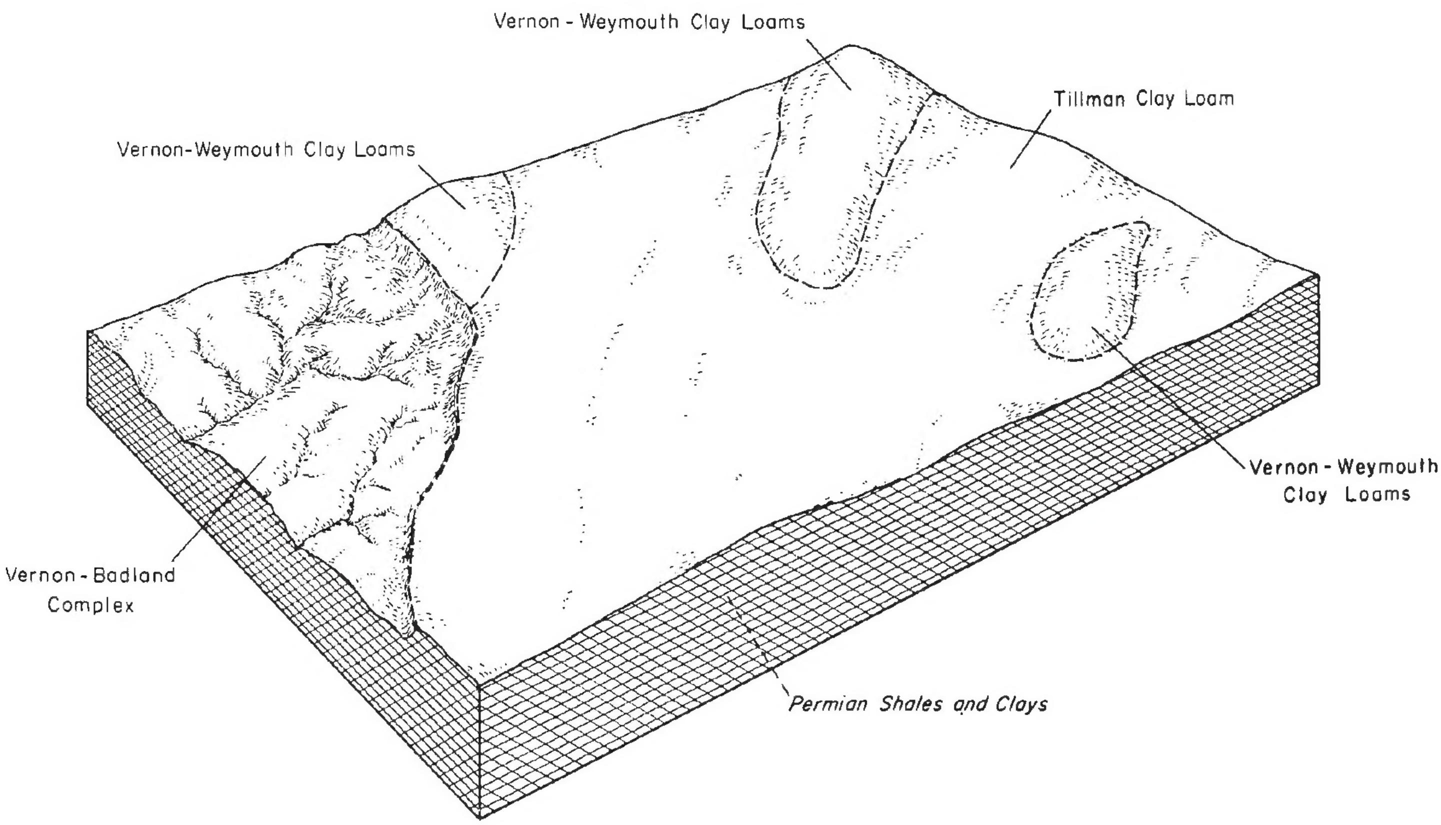

Figure 3.—Representative pattern of soils in association 2.

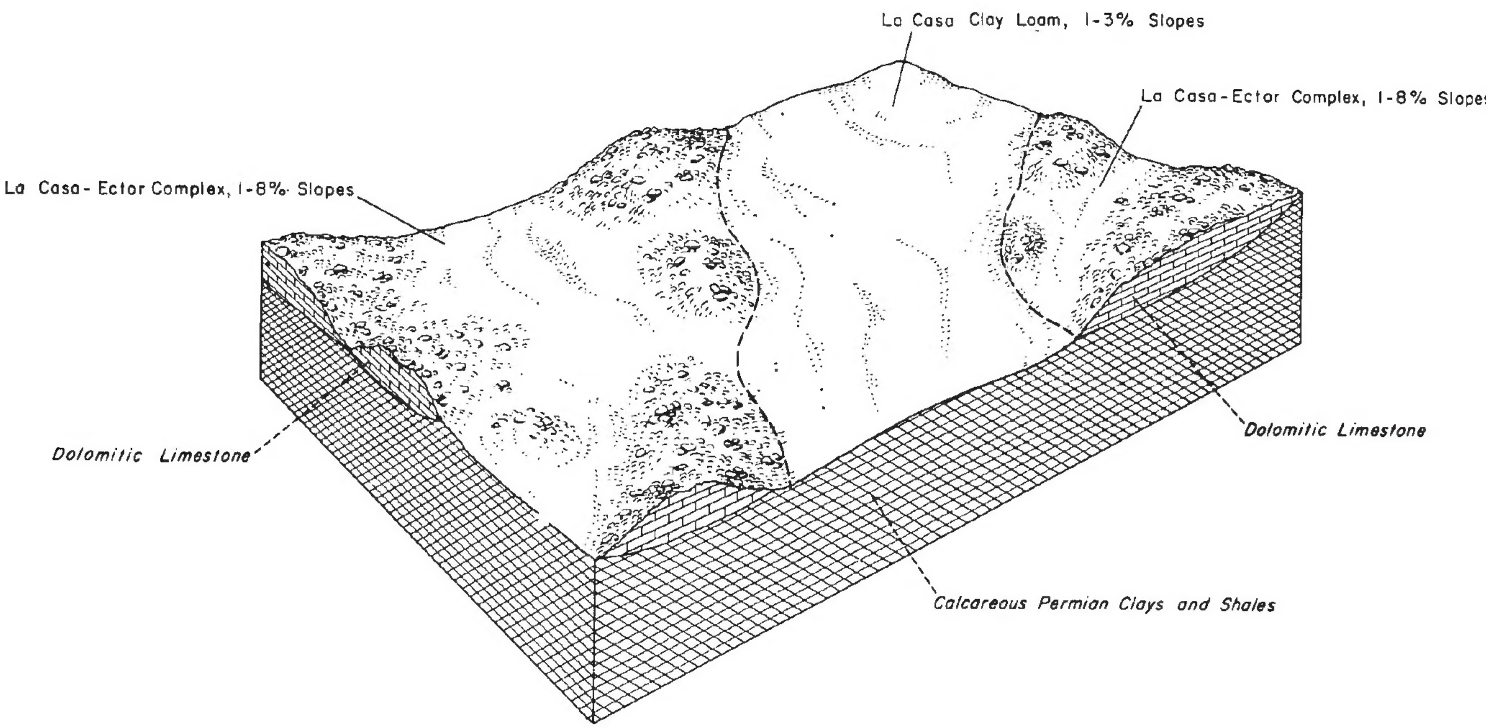

***Figure 4.*—Representative pattern of soils in association 3.**

are shallow or very shallow and are reddish brown in color. Their surface layer is clay or clay loam, and their subsoil is compact clay.

Minor soils in this association are the Weymouth, Hollister, Abilene, and Wichita, which make up about 10 percent of the total acreage.

Most of the acreage is in large ranches and is used as range. Some areas of the Tillman soils are cultivated successfully, largely to wheat and other small grains. The Tillman soils are fertile, but the shortage of rainfall limits yields in most years. The Vernon soils, which are mapped in complexes with the Weymouth soils, are unsuitable for cultivation.

3. *La Casa-Ector association: sloping hardland soils and shallow soils*

This association consists of gently sloping and sloping soils (fig. 4). It occurs as several irregularly shaped areas, mainly in the western part of the county. About 9 percent of the county is in this association.

The La Casa soils generally are gently sloping. These brown to reddish-brown clay loams are moderately deep and have a friable surface layer and subsoil. They make up about 70 percent of the association.

The Ector soils, which are sloping, dark colored, very shallow, and stony, are mainly on the narrow ridges and knobs. They are mapped both as a separate unit and in a complex with the less sloping La Casa soils. The Ector soils occupy about 24 percent of the association.

Minor areas of the Weymouth, Tillman, Vernon, and Hollister soils make up the rest of the association.

Most of the acreage is used as range. The La Casa soils are moderately productive of small grains, but they occur mostly as small areas that are impractical to cultivate.

4. *Enterprise-Tipton association: mixed land*

This association consists of nearly level and gently sloping soils that occur as narrow bands on the low terraces along the Pease River (fig. 5). Only about 1 percent of the county is in this association. Although the acreage is small, it is of major importance to the county.

The Enterprise soils are deep, brown to reddish brown, well drained, and very friable. The Tipton soils are deep, brown to very dark grayish brown, well drained, and friable. They are less sandy in the subsoil than the Enterprise soils.

Minor areas of the Springer and the Miles soils make up about 10 percent of the association.

Almost all of this soil association is cultivated. The soils are the most highly productive of wheat and cotton of any in the county and are among the better soils for growing alfalfa. Few conservation practices are required, other than maintaining good tilth. A soil-improving crop or the proper use of crop residues in the rotation is desirable.

5. *Wichita-Miles association: moderately sandy soils*

This association consists of nearly level to moderately sloping soils that for the most part form a high, rather narrow, irregularly shaped ridge in the east-central part of the county. About 6 percent of the county is in this association.

Both the Wichita and the Miles soils are deep and brown to reddish brown in color. The Wichita soils, which are the more extensive, have a subsoil that is more clayey, less crumbly, and more firm when moist than that of the Miles soils.

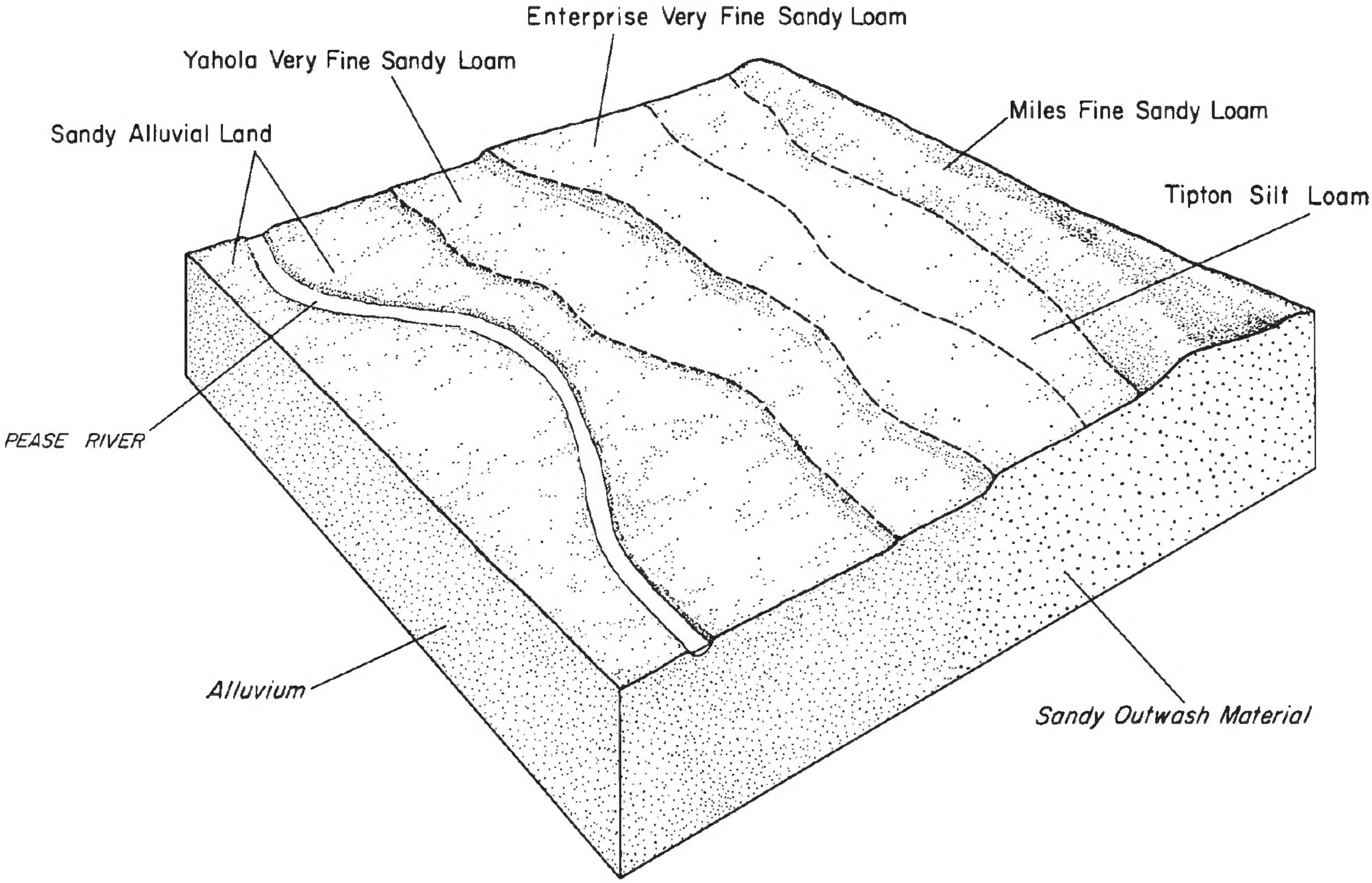

Figure 5.—Representative pattern of soils in association 4.

About 15 percent of this association consists of the Cobb and the Vernon soils.

Most of the acreage is cultivated and is used mainly for cotton, wheat, and grain sorghum. The soils are susceptible to wind and water erosion if they are not protected. Their surface layer is moderately coarse textured and moderately low in fertility.

6. *Miles-Springer association: sandy soils*

This association consists of gently rolling, coarse-textured soils (fig. 6) that occur in the northeastern part of the county between Paradise Creek and the Pease River. About 3 percent of the county is in this association.

Both the Miles and the Springer soils are deep and are brown to reddish brown in color. The Miles soils have a loose, structureless surface layer. Their subsoil is friable sandy clay loam. The Springer soils have a similar surface layer but a friable and crumbly subsoil of fine sandy loam.

Minor areas of Altus fine sandy loam make up about 5 percent of the association.

Approximately 95 percent of the acreage is cultivated. The main crops are cotton, grain sorghum, and alfalfa. Much of the area has ground water 16 to 30 feet below the surface. The soils are highly susceptible to wind erosion and ordinarily are low in available plant nutrients.

7. *Rough Broken Land association: rough land*

The broken land in this association consists of deposits of gypsum and of Permian red-bed material. It makes up about 19 percent of the county.

The largest area is in the northwestern part of the county. This area and a small area in the southwestern part of the county consist of steep escarpments exposing the raw red beds and, below the escarpments, benchlike, less strongly sloping areas that are dissected by deep gullies. These benchlike areas, which consist of the Cottonwood and the Acme soils, are highly productive of mid grasses because of their high content of gypsum.

An area in the southeastern part of the county consists mainly of Permian red-bed material, which forms steep escarpments that are dissected by deep gullies and drains. Except for the small but smooth ridges occupied by the Tillman, Vernon, and Weymouth soils, and the strips along the narrow alluvial drains, this area of broken land is almost devoid of vegetation.

Approximately 25 percent of this association consists of the Cottonwood, Acme, Vernon, Weymouth, and Tillman soils. This association is used mainly as range.

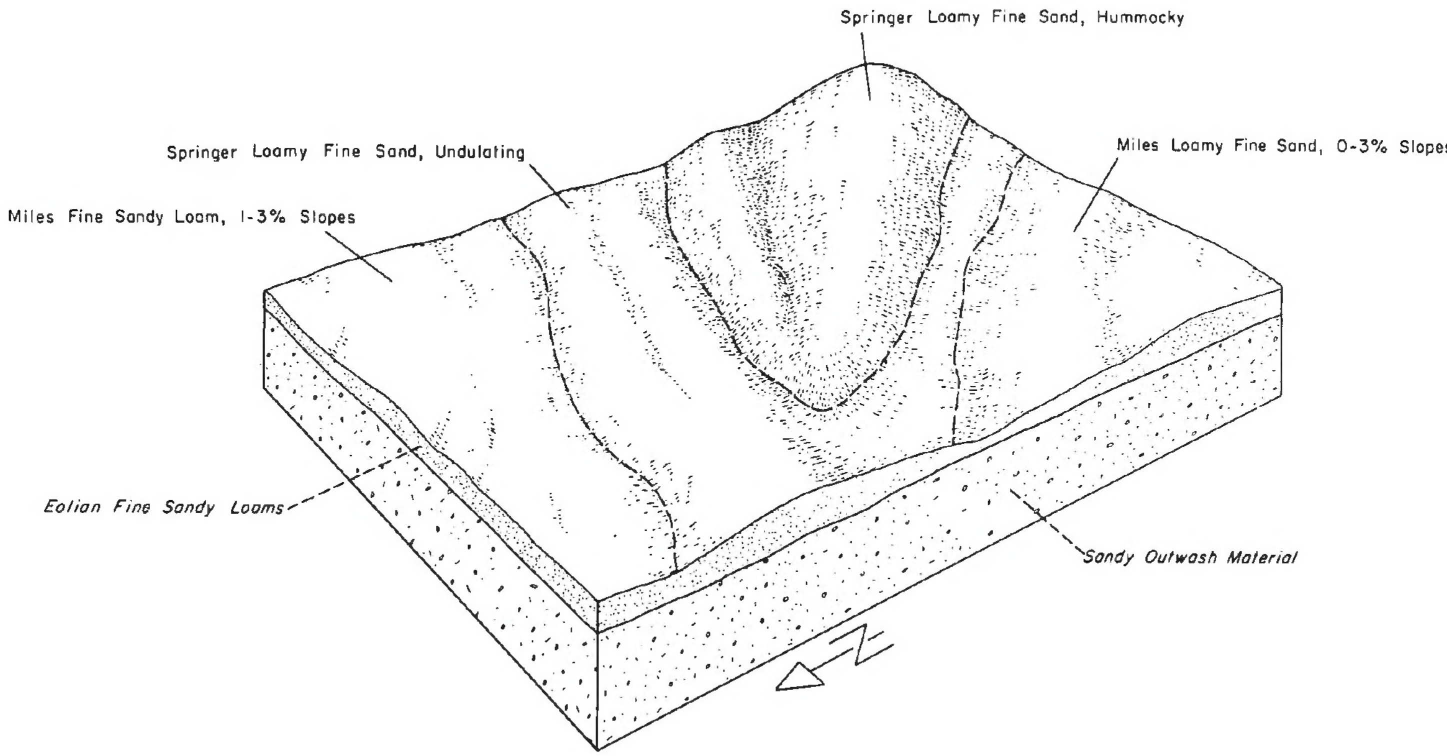

Figure 6.—Representative pattern of soils in association 6.

Descriptions of the Soils

This section describes the soil series (groups of soils) and mapping units (single soils) of Foard County. The acreage and proportionate extent of each mapping unit are given in table 1.

The procedure in this section is to describe first the soil series, and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read the description of that unit and also the description of the soil series to which it belongs. As mentioned in the section "How Soils are Mapped and Classified," not all mapping units are members of a soil series. Badland and Gravelly rough land are miscellaneous land types and do not belong to a soil series but, nevertheless, are listed in alphabetic order along with the soil series.

Following the name of each mapping unit, there is a symbol in parentheses. This symbol identifies the mapping unit on the detailed soil map. Listed at the end of each description of a mapping unit are the capability unit and the range site in which the mapping unit has been placed. The page on which each capability unit and each range site is described can be found readily by referring to the "Guide to Mapping Units" at the back of the report.

Soil scientists, engineers, students, and others who want detailed descriptions of soil series should turn to the section "Genesis, Morphology, and Classification of the Soils." Many terms used in the soil descriptions and other sections of the report are defined in the Glossary.

Abilene Series

The Abilene series consists of nearly level and gently sloping, deep, dark-colored, crumbly soils on the uplands. These soils occur throughout the eastern part of the county.

The surface layer is brown to very dark grayish-brown clay loam. It is about 6 inches thick, has a granular structure, and is friable when moist.

The subsoil, to a depth of about 56 inches, is more clayey than the surface layer, has a blocky structure, and crumbles easily but is firm when moist. The color is very dark grayish brown in the upper part and grades to light brown or reddish brown in the lower part. The lower part contains some accumulations of lime.

The underlying material consists of old, highly calcareous, reddish-yellow, water-laid clayey deposits that contain many nodules of lime.

A profile representative of an Abilene soil is shown in figure 7.

In some areas the surface layer is calcareous and is lighter colored. In some of the gently sloping areas, the limy layer below the subsoil is thin and inconspicuous.

These soils are somewhat like Hollister soils but are more friable and less clayey in the upper part of the subsoil. They are also somewhat like Wichita soils but have a darker colored and less reddish surface layer and subsoil. They have a darker colored surface layer than Tillman soils and a less clayey subsoil.

Abilene soils occur as broad flats interrupted by creeks and small tributaries, along which are distinct escarpments of rough broken land formed by geologic erosion. The Abilene soils near these escarpments have a thinner

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Abilene clay loam, 0 to 1 percent slopes	51, 700	12. 0
Abilene clay loam, 1 to 3 percent slopes	5, 460	1. 3
Abilene clay loam, 1 to 3 percent slopes, eroded	1, 020	. 2
Abilene-slickspot complex	320	. 1
Altus fine sandy loam	420	. 1
Badland	36, 440	8. 4
Cobb fine sandy loam, 1 to 3 percent slopes	3, 400	. 8
Cobb fine sandy loam, shallow variant	2, 180	. 5
Cobb-Quinlan complex	2, 250	. 5
Cottonwood-Acme complex	910	. 2
Cottonwood-Ector-Vernon complex	10, 600	2. 4
Cottonwood-Vernon-Acme complex	42, 000	9. 7
Ector soils	8, 730	2. 0
Enterprise very fine sandy loam, 0 to 1 percent slopes	820	. 2
Enterprise very fine sandy loam, 1 to 3 percent slopes	790	. 2
Enterprise very fine sandy loam, 3 to 5 percent slopes	240	. 1
Enterprise fine sandy loam, 0 to 1 percent slopes	790	. 2
Enterprise fine sandy loam, 1 to 3 percent slopes	530	. 1
Gravel pits	130	(1)
Gravelly rough land	1, 650	. 4
Hollister clay loam, 0 to 1 percent slopes	21, 800	5. 0
Hollister clay loam, 1 to 3 percent slopes	3, 580	. 8
Hollister clay loam, 1 to 3 percent slopes, eroded	260	. 1
La Casa clay loam, 1 to 3 percent slopes	4, 520	1. 0
La Casa-Ector complex	30, 000	6. 9
Loamy alluvial land	25, 250	5. 8
Miles loamy fine sand, 0 to 3 percent slopes	7, 560	1. 7
Miles fine sandy loam 0 to 1 percent slopes	3, 120	. 7
Miles fine sandy loam, 1 to 3 percent slopes	4, 200	1. 0
Miles fine sandy loam, 3 to 5 percent slopes	1, 500	. 3
Miller clay	1, 900	. 4
River channels	3, 250	. 7
Randall clay	430	. 1
Sandy alluvial land	1, 520	. 3
Springer loamy fine sand, undulating	6, 300	1. 5
Springer loamy fine sand, hummocky	700	. 2
Spur silt loam	2, 530	. 6
Spur clay loam	3, 880	. 9
Spur and Miller clay loams	5, 860	1. 4
Tillman clay loam, 0 to 1 percent slopes	16, 400	3. 8
Tillman clay loam, 1 to 3 percent slopes	57, 490	13. 3
Tillman clay loam, 1 to 3 percent slopes, eroded	410	. 1
Tipton silt loam	1, 640	. 4
Tivoli fine sand	770	. 2
Vernon-badland complex	28, 500	6. 6
Vernon-Weymouth clay loams, 1 to 3 percent slopes	6, 340	1. 5
Vernon-Weymouth clay loams, 3 to 5 percent slopes	8, 650	2. 1
Wichita clay loam, 1 to 3 percent slopes	2, 620	. 6
Wichita loam, 0 to 1 percent slopes	5, 510	1. 3
Wichita loam, 1 to 3 percent slopes	4, 360	1. 0
Yahola very fine sandy loam	1, 410	. 3
Total	432, 640	100. 0

[1] Less than 0.1 percent.

profile and a lighter colored subsoil. Those adjacent to the Miles soils have a slightly sandier surface layer.

Abilene soils can be tilled easily and worked into a good seedbed. Excessive tillage pulverizes the surface soil and causes crusting after rains. A plowpan is likely to form if these soils are always tilled at the same depth.

Abilene soils are well drained and are suited to small grain, cotton, grain sorghum, and native grasses. The main cultivated crop is wheat. The present vegetation on rangeland is short and mid grasses.

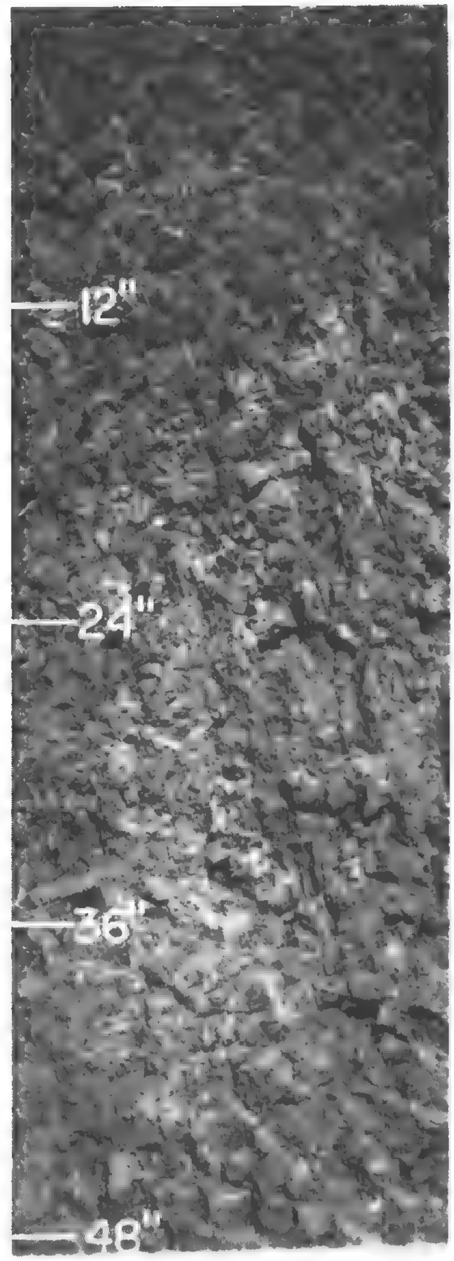

Figure 7.—A profile of Abilene clay loam.

Abilene clay loam, 0 to 1 percent slopes (AbA).—This soil is one of the most extensive in the county. Included in the areas mapped are small areas of Randall clay; Hollister clay loam, 0 to 1 percent slopes; Wichita clay loam, 1 to 3 percent slopes; and Vernon-Weymouth clay loams, 1 to 3 percent slopes. These inclusions make up approximately 8 percent of the acreage.

Except for a few areas, all of this soil is cultivated. It is easily tilled and is well suited to small grain, cotton, and grain sorghum. Water erosion is not a problem. (Capability unit IIc-1; Deep Hardland range site)

Abilene clay loam, 1 to 3 percent slopes (AbB).—This gently sloping soil occurs along shallow drains and on ridges within areas of Abilene clay loam, 0 to 1 percent slopes. The slope is ordinarily between 1 and 2 percent. Included in the areas mapped are small areas of Spur clay loam; Tillman clay loam, 0 to 1 percent slopes; and Vernon-Weymouth clay loams, 1 to 3 percent slopes. These inclusions make up about 6 percent of the acreage.

In cultivated areas the effect of water erosion is evident along the side slopes of shallow drains. A few gullies 4 to 10 inches deep and 2 to 15 feet wide have formed. In some areas the surface layer has been thinned a few inches by sheet erosion. (Capability unit IIe-1; Deep Hardland range site)

Abilene clay loam, 1 to 3 percent slopes, eroded (AbB2).—This gently sloping soil is along shallow drains. As a result of erosion, gullies 8 to 20 inches deep and 8 to 18 feet wide have formed. Included in the areas mapped are small areas of Abilene clay loam, 1 to 3 percent slopes, and Vernon-Weymouth clay loams, 1 to 3 percent slopes. These inclusions make up about 5 percent of the acreage.

This soil has been eroded to the extent that only an inch or two of the original surface layer remains, and in several areas the subsoil is exposed as much as 200 feet back on either side of drains. A few rills have formed on the side slopes of the drains.

This soil is used mostly for small grain, but it is best suited to native grasses. Most of the drains can be crossed with farm machinery. (Capability unit IIIe-2; Deep Hardland range site)

Abilene-slickspot complex (Ak).—This complex consists of nearly level areas of Abilene clay loam, which makes up more than half of the acreage, and slickspots, also called "alkali spots" (fig. 8). Included in the areas

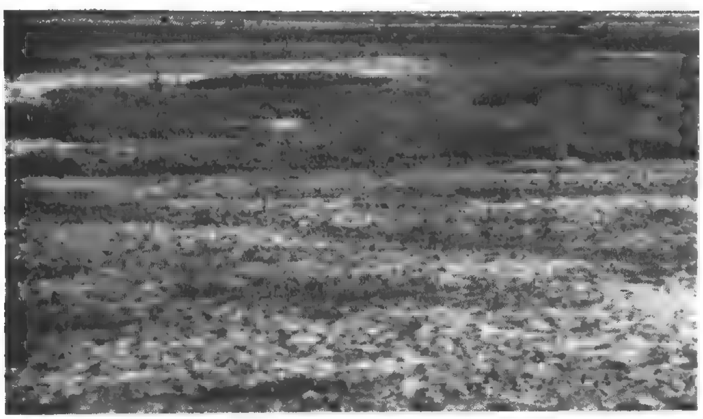

Figure 8.—**Area of Abilene-slickspot complex.**

mapped are small areas of Miles fine sandy loam and one small area of a poorly drained variant of Altus fine sandy loam, which occurs along Paradise Creek and contains several saline spots. These inclusions make up about 5 percent of the acreage. They are used and managed like the other soils in the complex.

The Abilene soil of this complex has a thin, gray crust that can be seen when the surface layer has been wetted and allowed to dry. Nodules of lime ordinarily occur about 30 inches below the surface. In other characteristics, however, this soil is similar to the Abilene soils previously described.

The slickspots are irregularly shaped and range from 150 to 1,000 feet in diameter. Their surface layer is dark grayish-brown clay loam. It is 4 to 8 inches thick and has a granular structure. It puddles easily when wet and forms a hard crust when dry. The subsoil is brown to grayish-brown, calcareous clay that is very hard when dry and very sticky when wet. A strongly calcareous horizon occurs 35 to 45 inches beneath the surface.

Moderate yields of the crops commonly grown are obtained on the Abilene soil during years of normal rainfall. Some of the slickspots, however, are so strongly saline that they cannot support plants. A few will produce low yields in years when rainfall is plentiful. (Capability unit IIIs-2; Deep Hardland range site)

Acme Series

The Acme series consists of gently sloping, shallow, dark-colored soils on the uplands. These soils are in the northwestern and southwestern parts of the county.

The surface layer is brown to dark grayish-brown clay loam. It is about 6 inches thick, has a subangular blocky stucture, and is very hard when dry and friable when moist. In most places this layer contains an accumulation of lime.

The subsoil, to a depth of about 18 inches, is brown to dark grayish-brown clay loam. It has a subangular blocky structure but breaks easily to granules. Ordinarily there is some accumulation of lime in this layer.

The underlying material is white gypsum. The gypsum is weathered and crumbles easily in the upper part but becomes more massive with depth.

The surface layer is 6 to 12 inches thick and ranges from noncalcareous to strongly calcareous. Depth to the parent material ranges from 16 to 22 inches.

In Foard County Acme soils are mapped only with Cottonwood and Vernon soils. They are deeper than Cottonwood soils.

Acme soils are used mainly as range. The vegetation is short and mid grasses.

Altus Series

The Altus series consists of dark-brown soils that are moderately coarse textured. These soils are nearly level and occur in concave areas on the uplands in the northeastern part of the county.

The surface layer is brown to dark grayish brown. It has granular structure, is about 6 to 8 inches thick, and is slightly hard when dry but friable when moist. It is easy to till and to work into a good seedbed.

The subsoil is very dark grayish-brown sandy clay loam. It has a subangular blocky structure, is about 40 inches thick, and is slightly more compact than the surface layer. Ordinarily it contains an accumulation of lime.

The substratum consists of moderately sandy outwash material or ancient alluvium.

In some areas the surface layer is less sandy, and in a few areas it is calcareous. In some areas the subsoil is lighter colored and lacks an accumulation of lime.

Altus soils have a darker colored surface layer and subsoil than the closely associated Miles soils. They have a sandier surface layer than Tipton soils, and all their layers overlying the parent material are more sharply defined.

Figure 9.—**Typical area of Badland.**

Altus fine sandy loam (Am).—This soil is nearly level; the slope ordinarily is less than 1 percent. Included in the areas mapped are small areas of Miles fine sandy loam, 0 to 1 percent slopes, which in some places make up as much as 5 percent of the acreage.

This soil is well drained and absorbs water readily. Because of its high natural fertility and the lay of the land, most of the acreage is cultivated. High yields of cotton, alfalfa, and small grain are obtained.

Wind erosion is slight if this soil is not protected. (Capability unit IIe-4; Sandy Loam range site)

Badland (Ba)

Badland is a miscellaneous land type consisting mainly of shales and clays of the Permian red beds. It includes escarpments bordering level soils of the uplands and areas below these escarpments. This land supports little vegetation. It is thoroughly dissected by large gullies and by bald ridges and knobs of red-bed material (fig. 9). The slope range is dominantly 2 to 12 percent, but along some of the gullies it ranges from 20 to 75 percent. Included in the areas mapped are several hundred acres of red-bed sandstone, which are in the north-central part of the county along Blacks Branch Creek. Small outcrops or ledges of gypsum occur in some places. These inclusions have similar landscape characteristics and therefore are used and managed like other areas in this land type.

The escarpment formation is a distinctive feature, even though it is very narrow and its acreage is relatively small. In some areas along the Wichita River, 50 to 75 percent of the acreage consists of gullies. In most of these areas there are small interridges of deeper soils that support some short grasses; otherwise, the vegetation is very scant. Gravel, some of which is the size of cobblestones, occurs in some areas. In these areas the red beds are weathered to a depth of about 4 inches in places. Ordinarily, any accumulated soil is eroded away after each rain. Where the grade is nonerodible, as at the bottom of gullies, there is a slight accumulation of soil material that supports some mid grasses. (Capability unit VIIIs-1; not in a range site)

Cobb Series

The Cobb series consists of well-drained soils on the uplands. These soils are shallow to moderately deep over sandstone. They occur along a ridge that extends from northeast to southwest in the north-central part of the county.

The surface layer is reddish-brown fine sandy loam. It is ordinarily about 6 inches thick, is granular in structure, and is very friable when moist.

The subsoil, to a depth of about 28 inches, is red to reddish-brown sandy clay loam. It has a subangular blocky structure but breaks easily to granules. It is easily penetrated by roots, air, and water. Ordinarily, there is no accumulated lime in this layer.

The parent material is weathered, fine-grained sandstone of the red-bed formation. In places some lime has accumulated in this layer (fig. 10).

These soils ordinarily are uniform in profile characteristics, but in some areas the subsoil is more clayey.

Figure 10.—**Profile of Cobb fine sandy loam.**

Depth to the parent material ranges from 10 to 50 inches.

Cobb soils differ from Miles soils in that they are redder and have sandstone parent material. They are less clayey in the subsoil than Wichita soils.

Cobb soils are droughty and are best suited to crops that have short growing periods. Their natural fertility is moderately low. The present range vegetation is short and mid grasses.

Cobb fine sandy loam, 1 to 3 percent slopes (CoB).—This soil has gentle convex slopes. Included in the areas mapped are small areas of Cobb fine sandy loam, shallow variant, and Wichita clay loam, 1 to 3 percent slopes. These inclusions make up about 8 percent of the acreage but are managed like the Cobb soil.

Except for a few small tracts along drainageways, most of this soil is cultivated. It is better suited to small grain than to cotton, but fair yields of cotton can be obtained in years when rainfall is plentiful. The hazard of wind and water erosion is slight. (Capability unit IIIe–7; Sandy Loam range site)

Cobb fine sandy loam, shallow variant (Cs).—This soil has gentle convex slopes and generally occupies the upper part of the sandstone ridge. It is similar to Cobb fine sandy loam, 1 to 3 percent slopes, but is only about 16 inches deep to the parent material. It is less clayey in the surface layer and subsoil than Vernon soils.

Included in the areas mapped are small areas identical with this soil but on stronger slopes of about 4 percent, and some small patches of Cobb fine sandy loam, 1 to 3 percent slopes. These inclusions together make up about 7 percent of this mapping unit. In some areas concentrated runoff has removed more than half the surface layer of this soil. These eroded areas differ from the rest of the soil in use and management needed but are too small to be mapped or managed separately. Sandstone parent material outcrops throughout the areas of this soil.

Because this soil is shallow and droughty, it is poorly suited to row crops and is used mainly for small grain and sudangrass. Approximately 40 percent of the acreage is cultivated. The soil is slightly susceptible to wind and water erosion. (Capability unit IVe–3; Sandy Loam range site)

Cobb-Quinlan complex (Cu).—This complex consists of a Cobb soil that is somewhat like Cobb fine sandy loam, shallow variant, and of the shallow Quinlan fine sandy loam. These soils have moderate convex slopes and occur on the upper part of the sandstone ridge and along some of the drainageways. The Cobb soil makes up about 65 percent of the acreage. Included in the areas mapped are small areas of Cobb fine sandy loam, 1 to 3 percent slopes, which make up about 3 percent of the acreage.

Quinlan soil is somewhat similar to Cobb soils in color, but it has a less clayey subsoil. Both soils formed over the same parent material. Quinlan soil is not mapped separately in this county but is described in this section under "Quinlan Series."

The soils of this complex are shallow and droughty and are best suited to range. Several areas once cultivated are now retired from cultivation. The soils are moderately susceptible to water erosion. Erosion has been only slight on most of the acreage, but it has removed most of the surface layer in a few places. A few shallow gullies occur along the drainageways. Red-bed sandstone outcrops within the Quinlan part of this complex.

The Cobb soil in this complex is in capability unit IVe–3, and the shallow Quinlan fine sandy loam is in capability unit VIe–2. Both soils are in the Sandy Loam range site.

Cottonwood Series

The Cottonwood series consists of nearly level and gently sloping, shallow, dark-colored soils on the uplands. These soils are in the western part of the county.

The surface layer is brown to dark grayish-brown clay loam and is about 4 inches thick. It is hard when dry, but it is very friable when moist and breaks into fine granular particles. In most places there is an abrupt boundary between this layer and the gypsum below it.

The material under the surface soil is white gypsum. It is weathered and crumbles easily in the upper part but is more massive with increasing depth (fig. 11).

Variations in the profile are uncommon but do occur in some places. The surface layer ranges from 2 to 10 inches in thickness and from weakly to strongly calcareous in reaction. Some areas that are mapped with other soils as complexes have a lighter colored surface layer than is typical for the series.

Cottonwood soils in this county are mapped only in complexes with Acme, Vernon, and Ector soils. They have a darker colored and more friable surface layer than Vernon soils and are shallower than Acme soils. They are somewhat like Ector soils, which formed in limestone material.

Because they are shallow, Cottonwood soils are used mainly as range. The vegetation consists of short and mid grasses.

Cottonwood-Acme complex (Cw).—This complex is about 48 percent Cottonwood soils, 40 percent Acme soils, and 12 percent Abilene clay loam. It occurs below ridges occupied by Ector soils and also in broad valleys. Included in the areas mapped are small areas of Vernon clay loam, 1 to 3 percent slopes, which is used and managed like the other soils in the complex.

These soils are nearly level; their slope averages about 0.8 percent. In some places the gypsum-bearing substratum is about 50 inches below the surface layer.

These soils are not suitable for cultivation because there are many areas of the very shallow Cottonwood soil. If cultivated, the Cottonwood soil is slightly susceptible to wind erosion. All of the soils are slightly susceptible to water erosion.

Cottonwood clay loam is in capability unit VIIs–1 and in the Gyp Land range site. Acme clay loam is in capability unit IVe–3 and in the Deep Hardland range site.

Cottonwood-Ector-Vernon complex (Cx).—This complex is about 40 percent Cottonwood soils, 40 percent Ector soils, and 20 percent Vernon clay loam. It occurs along drains and on ridges on the uplands in the southwestern part of the county. The slope ranges from gently sloping to steep but is ordinarily about 10 percent.

The Cottonwood soil is generally below the Ector soil and is along drains. The Ector soil occurs as narrow ridges and knolls and generally is parallel to the long slopes. Vernon clay loam occurs in various positions.

The Cottonwood soil is gently sloping to sloping and resembles the soils described under "Cottonwood Series." Its surface layer is very thin, and the parent material is exposed in some places.

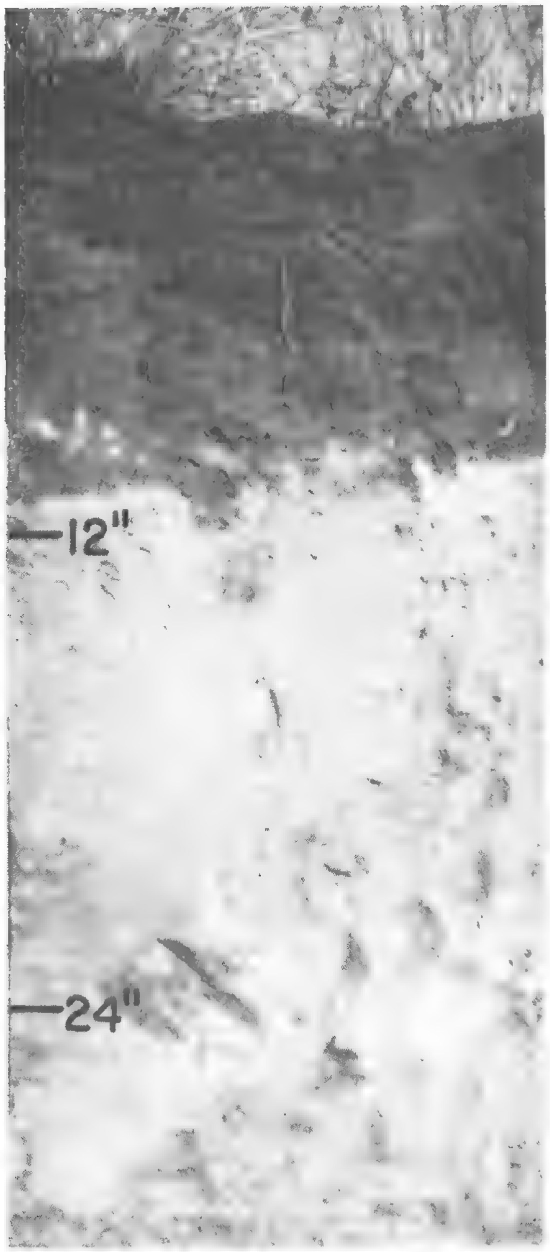

Figure 11.—**Profile of Cottonwood clay loam. Surface layer is thicker than is normal for soils of this series.**

The very shallow Ector soil has a surface layer of dark-colored loam that is only about 5 inches thick. This layer is slightly hard when dry, but it is very friable when moist and breaks into fine granules. In most places the Ector soil contains limestone fragments. Its substratum is gray limestone of Permian age.

The shallow Vernon soil has a surface layer of brown to reddish-brown clay loam. This layer is about 5 inches thick. It is very hard when dry and sticky when wet. The reddish-brown subsoil is about 10 inches thick; it is hard when dry and in some places contains a few nodules of lime. The parent material consists of calcareous clay and shale of the Permian red beds.

The present vegetation on this complex is mid and short grasses and scattered redberry juniper trees.

Cottonwood clay loam is in capability unit VIIs–1 and in the Gyp Land range site. The Ector soil is in capability unit VIIs–1 and in the Very Shallow range site. Vernon clay loam is in capability unit VIe–2 and in the Shallow Redland range site.

Cottonwood-Vernon-Acme complex (Cy).—This complex is about 40 to 50 percent Cottonwood soils or gypsum, 25 to 40 percent Vernon soils, and 5 to 15 percent Acme soils. Included in the areas mapped are areas of Vernon-badland complex, which generally occur along the gullies, and Spur and Miller soils, which occur along the larger creeks.

This complex occurs on a series of steep ridges where the slope is as much as 70 percent and on the many steplike benches below these ridges (fig. 12). The benches are 30 to 200 feet wide and have a slope of about 3 percent.

Figure 12.—**Typical area of the Cottonwood-Vernon-Acme complex.**

Each bench ordinarily is 4 to 15 feet higher than the one below. For the most part the soils of this complex occur in the northwestern part of the county along Talking John, Cactus, and Blacks Branch Creeks; along tributaries of these creeks; and along several intermittent streams and deep gullies.

The surface layer in this complex is variously colored reddish brown, yellowish brown, or gray. In some places this layer is puffy and appears moist because it consists mainly of gypsum. The material underlying these soils is shale and clay of the Permian red beds, interbedded and mixed with gypsum and limestone.

On the benches the vegetation is short grasses, and on the side slopes it is mid and tall grasses.

Cottonwood clay loam is in capability unit VIIs 1 and in the Gyp Land range site. Vernon clay loam is in capability unit VIe–2 and in the Shallow Redland range site. Acme clay loam is in capability unit IVe–3 and in the Deep Hardland range site.

Ector Series

The Ector series consists of gently sloping to strongly sloping, very shallow, dark-colored soils on the uplands. These soils are in the western part of the county.

The surface layer is dark grayish brown. It is about 5 inches thick, is of granular structure, and is slightly hard

when dry but very friable when moist. It is calcareous and contains limestone fragments in most places. This layer grades abruptly to the parent material, which is gray limestone of Permian origin that appears to be fractured but is thick bedded.

Within short distances the thickness of the surface layer varies between 1 and 8 inches. The stoniness also varies somewhat, but in practically all areas it is sufficient to affect materially the growth of vegetation (fig. 13).

Figure 13.—Area of Ector soils.

Ector soils are somewhat like Cottonwood soils but have different parent material. They have a darker colored surface layer than Vernon soils, which formed in red-bed clays.

Because they are shallow, these soils are used mainly as range. The vegetation is short and mid grasses.

Ector soils (Ec).—These soils are on narrow ridge crests and slopes. They are ordinarily moderately sloping but range from gently sloping to strongly sloping. Included in the areas mapped are small areas of La Casa clay loam, 1 to 3 percent slopes, and Vernon-Weymouth clay loams, 1 to 3 percent slopes. These inclusions make up about 8 percent of the mapping unit.

Because they are shallow, these soils are not suitable for cultivated crops. Little water erosion has occurred. (Capability unit VIIs-1; Very Shallow range site)

Enterprise Series

The Enterprise series consists of deep, brown to reddish-brown, loamy soils on the uplands. These soils are on low terraces adjacent to the Pease River in the northeastern part of the county.

The surface layer, to a depth of about 18 inches, is granular, brown to reddish-brown very fine sandy loam or fine sandy loam. It is slightly hard when dry but very friable when moist. In most places it is calcareous. It can be tilled easily, and it works into a good seedbed.

The subsoil, to a depth of about 46 inches, is granular, reddish-brown very fine sandy loam or fine sandy loam. It is easily penetrated by roots, moisture, and air. Ordinarily, it contains films and threads of lime.

The parent material is wind-laid, medium-textured material, probably blown from ancient riverbeds. It may extend 10 to 15 feet below the surface. Films and threads of lime ordinarily accumulate in this layer (fig. 14).

The surface layer ranges from 16 to 30 inches in thickness, is coarser textured than a fine sandy loam in a few places, and is weakly calcareous in some areas.

Enterprise soils have a lighter colored surface layer and a less clayey subsoil than Tipton soils. They are finer textured than Tivoli soils.

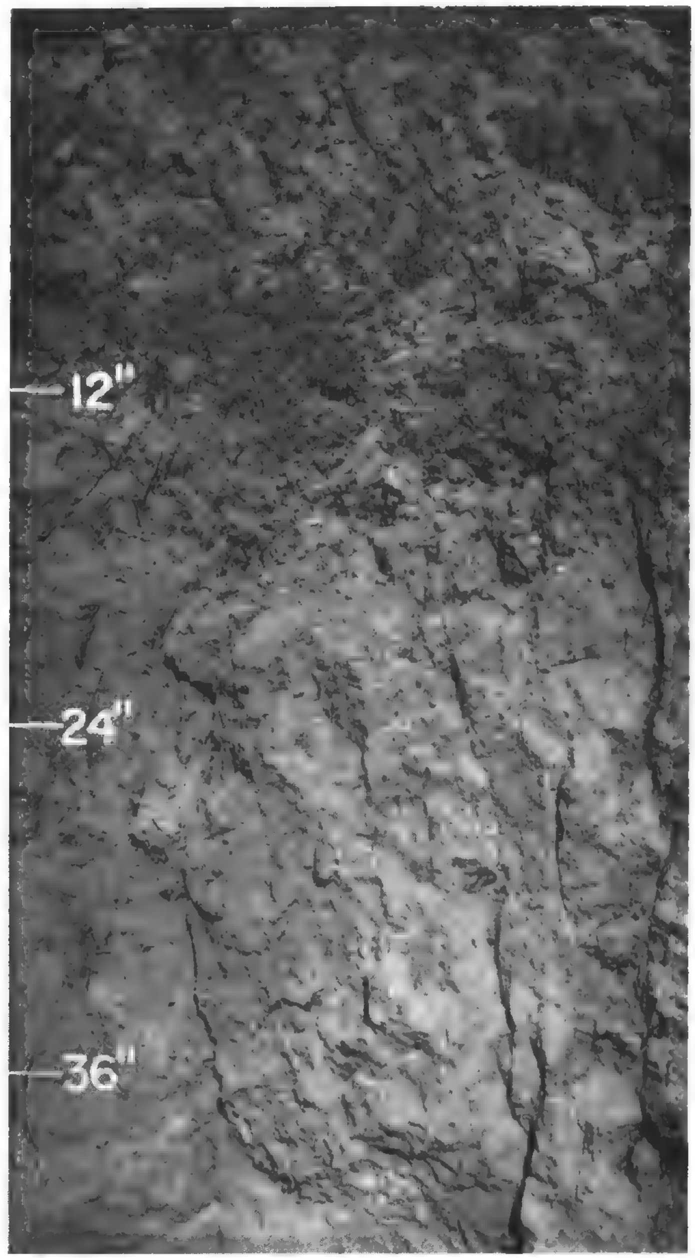

Figure 14.—Profile of Enterprise very fine sandy loam.

Enterprise soils are permeable and well drained. There is little runoff other than that occurring on moderate slopes during heavy rains.

Enterprise soils are well suited to most of the crops and grasses commonly grown. The present rangeland vegetation is short and mid grasses.

Enterprise very fine sandy loam, 0 to 1 percent slopes (EnA).—This soil has the properties described for soils of the Enterprise series. Included in the areas mapped are areas of Tipton silt loam and a small acreage of Enterprise very fine sandy loam, 1 to 3 percent slopes. These inclusions make up about 3 percent of the total acreage.

Except for a few areas that are inaccessible, practically all of this soil is cultivated. It is one of the most productive soils in the county and is well suited to cotton, small grain, grain sorghum, and alfalfa. (Capability unit IIc–2; Mixed Land range site)

Enterprise very fine sandy loam, 1 to 3 percent slopes (EnB).—This soil has convex slopes that average about 2 percent. In most areas the surface layer is reddish brown. Included in the areas mapped are areas of Enterprise very fine sandy loam, 0 to 1 percent slopes, which make up about 2 percent of the acreage.

Except for a few small tracts along drainageways, most of this soil is cultivated. It is well suited to cotton, small grain, grain sorghum, and alfalfa. The hazard of water erosion is slight if this soil is not protected. Runoff has formed shallow gullies in a few places. (Capability unit IIe–3; Mixed Land range site)

Enterprise very fine sandy loam, 3 to 5 percent slopes (EnC).—This soil has convex slopes that average about 4 percent. The surface layer ordinarily is about 14 inches thick and is redder than that of other soils of the series. Included in the areas mapped are a few small areas that have lost most of their surface layer by erosion and have slopes as steep as 7 percent. These inclusions make up only a small part of the total acreage and do not significantly affect use and mangement of this soil.

This soil is used mainly for small grain. It is moderately susceptible to water erosion if not protected. Most of the acreage is only slightly eroded. (Capability unit IIIe–3; Mixed Land range site)

Enterprise fine sandy loam, 0 to 1 percent slopes (EfA).—The surface layer of this soil is about 14 inches of fine sandy loam. The subsoil is of the same texture. Included in the areas mapped are areas of Tipton silt loam, which make up about 2 percent of the mapping unit, and small areas of Enterprise very fine sandy loam, 0 to 1 percent slopes, and Enterprise fine sandy loam, 1 to 3 percent slopes.

Most of this soil is cultivated. It is well suited to cotton, small grain, grain sorghum, and alfalfa. It is lower in natural fertility than the Enterprise very fine sandy loams. If it is not protected, the hazard of erosion is slight. In some cultivated areas the surface layer has been winnowed; here, some of the silt, clay, and sand has been blown away and the plow layer is now more sandy. (Capability unit IIe–6; Sandy Loam range site)

Enterprise fine sandy loam, 1 to 3 percent slopes (EfB).—This soil has gentle convex slopes that average about 1.8 percent. It is lighter colored than Enterprise fine sandy loam, 0 to 1 percent slopes. It occurs both as narrow bands and as areas that are as much as 60 acres in size. Included in the areas mapped are areas of Enterprise fine sandy loam, 0 to 1 percent slopes, and Enterprise very fine sandy loam, 1 to 3 percent slopes. These inclusions make up about 3 percent of this soil.

This moderately coarse textured soil is well suited to cotton, small grain, grain sorghum, and alfalfa. It is lower in natural fertility than the Enterprise very fine sandy loams. If it is not protected, the hazards of wind and water erosion are slight. In some areas the surface layer has been thinned 2 or 3 inches through erosion. (Capability unit IIIe–5; Sandy Loam range site)

Gravelly Rough Land (Gr)

This land type consists of moderately sloping to steep, hilly areas on narrow rolling ridge crests and ridge slopes along the Wichita and Pease Rivers. The ridges range from 200 to 1,200 feet in width. The slope varies between 4 and 10 percent. In many of the areas, the ridges are divided by small valleys, which are 20 to 100 feet wide and are 10 to 50 feet lower than the ridges. The slope in the valleys varies between 12 and 20 percent (fig. 15).

Figure 15.—An area of Gravelly rough land.

The surface material, to a depth of about 24 inches, is gravelly fine sandy loam. As much as 20 to 60 percent of this layer consists of waterworn quartz gravel and pebbles. The underlying material ordinarily consists of shale and clay of the Permian red beds.

The present range vegetation is mid and short grasses. (Capability unit VIs–1; Gravelly range site)

Hollister Series

The Hollister series consists of nearly level and gently sloping, deep, brown to dark grayish-brown soils on the uplands.

The surface layer is brown to very dark grayish-brown clay loam and is about 6 inches thick. It is hard when dry and friable when moist. It breaks readily into small granules.

The subsoil, to a depth of about 58 inches, is dark brown to very dark grayish brown. It has a blocky structure and is very hard when dry and firm when moist. The upper part is clay loam, and the clay content normally increases with depth. The lower part contains small nodules of lime.

The substratum, to a depth of 6 feet or more, consists of calcareous clay and shale of the Permian red beds (fig. 16).

Figure 16.—A profile of Hollister clay loam.

The surface layer ordinarily is noncalcareous; depth to lime in most places is 24 to 60 inches. There are, however, circular areas where the surface layer is calcareous and is lighter colored.

Hollister soils are similar to Abilene soils but are less crumbly and have a more clayey subsoil. They are darker colored in the surface layer and subsoil than Tillman soils and are darker colored and more clayey in the subsoil than La Casa soils.

Hollister soils are suited to small grain, cotton, grain sorghum, and native grasses. Wheat is the main crop. The present rangeland vegetation is short grasses.

Hollister clay loam, 0 to 1 percent slopes (HcA).—This nearly level soil is in the southern part of the county. Some of the areas are extensive. Included in the areas mapped are small areas of Tillman clay loam, 0 to 1 percent slopes; Abilene clay loam, 0 to 1 percent slopes; and Hollister clay loam, 1 to 3 percent slopes. These inclusions make up about 6 percent of the acreage. They are used and managed like this Hollister soil.

About 60 percent of this soil is cultivated. It can be tilled easily and worked into a good seedbed. It is well suited to small grain, cotton, and grain sorghum. Most areas on large ranches are used as range. (Capability unit IIc-1; Deep Hardland range site)

Hollister clay loam, 1 to 3 percent slopes (HcB).—This soil has gentle convex slopes and occurs along shallow drains and on narrow ridges within areas of Hollister clay loam, 0 to 1 percent slopes. Included in the areas mapped are small areas of Tillman clay loam, 1 to 3 percent slopes; of Vernon-Weymouth clay loams, 1 to 3 percent slopes; and of Hollister clay loam on slopes of 1 percent or less. These inclusions make up about 5 percent of the acreage. They differ from this soil in use and management needed but are too small to be mapped separately.

In cultivated areas the effects of water erosion are noticeable along the shallow drains. In some places a few gullies have formed; these are 4 to 10 inches deep and 2 to 15 feet wide. In places the surface layer has been thinned 2 to 3 inches by sheet erosion.

Small grain and grain sorghum are the main cultivated crops. (Capability unit IIe-1; Deep Hardland range site)

Hollister clay loam, 1 to 3 percent slopes, eroded (HcB2).—This gently sloping soil is along shallow drains. As a result of water erosion, gullies 8 to 20 inches deep and 5 to 20 feet wide have formed. Except in a few small areas, this soil has been eroded to the extent that only an inch or two of the original surface layer remains. The subsoil is exposed as much as 200 feet back on either side of the drains. A few gullies have formed on the side slopes of the drains.

Most of this soil is cultivated, mainly to small grain. Generally, the drains can be crossed with farm machinery. (Capability unit IIIe-2; Deep Hardland range site)

La Casa Series

The La Casa series consists of brown to reddish-brown, calcareous, moderately deep, soils on the uplands. These soils are widely distributed throughout the western part of the county.

The surface layer is about 6 inches thick, is of granular structure, and is slightly hard when dry but friable when moist.

The subsoil, about 25 inches thick, is brown to reddish-brown silty clay loam. This layer has subangular blocky structure that breaks to fine granular. Moisture and roots penetrate it with little difficulty. Ordinarily, there is some accumulation of lime in the lower part.

The parent material consists of highly calcareous, moderately fine textured Permian clay and limestone. In most places it contains a large amount of accumulated lime (fig. 17).

Variations in the profile are not common, but in the more nearly level areas the profile may have some of the characteristics of Hollister clay loam. On the narrow ridges in the more rolling landscape, the surface layer and subsoil tend to be thinner and redder and to contain more lime. Depth to the layer of lime ranges from 22 to 55 inches.

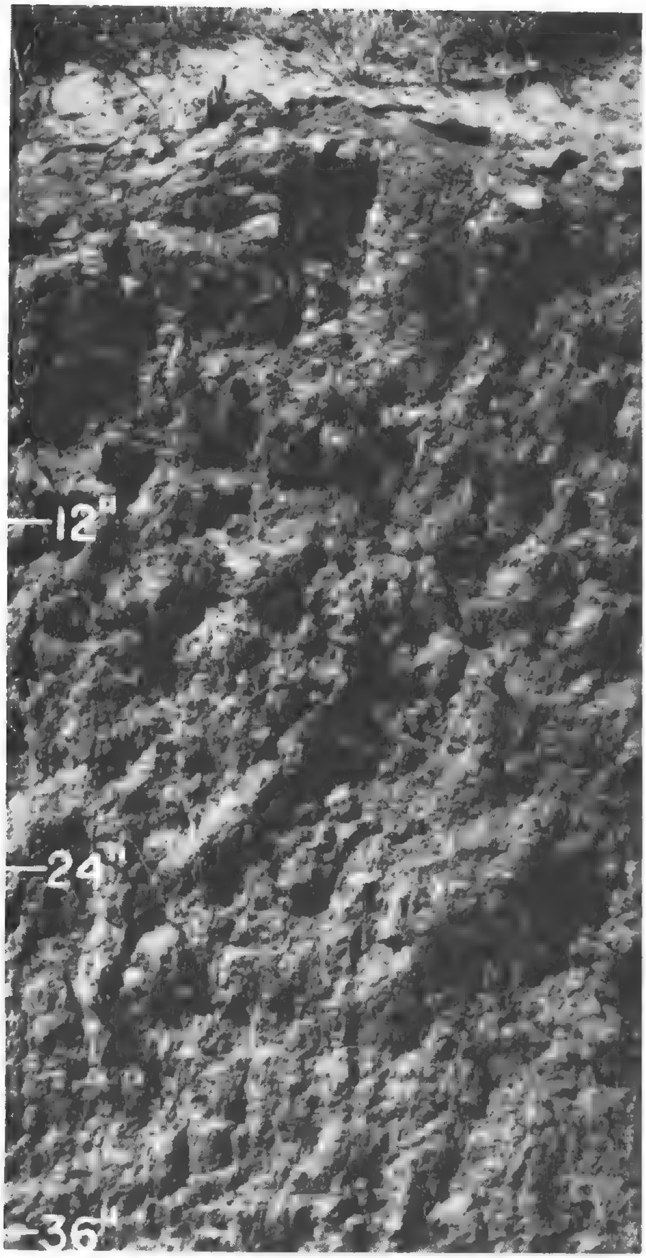

Figure 17.—**Profile of La Casa clay loam.**

La Casa soils are deeper and ordinarily are darker colored than Vernon or Weymouth soils. They have a redder, less clayey, and more friable subsoil than Hollister soils and a more friable, clayey subsoil that contains a larger amount of lime than that in Tillman soils.

These somewhat droughty soils have moderate natural fertility. They are best suited to small grains or similar crops that have a short growing season. The present range vegetation is short grasses.

La Casa clay loam, 1 to 3 percent slopes (LaB).—This soil has gentle convex slopes and ordinarily occurs below the higher ridges occupied by the Ector soils. Included in the areas mapped are small areas of Vernon-Weymouth clay loams, 1 to 3 percent slopes; Ector soils; and Hollister clay loam, 1 to 3 percent slopes. These inclusions make up about 12 percent of the acreage. They differ from this soil in management required but are too small to be mapped or managed separately.

Most of this soil has been used as range because it occurs as small, irregularly shaped tracts that for the most part are interwoven with the Ector soils. In cultivated areas this soil is best suited to small grain. Wheat is the main crop. When rainfall is plentiful, fair yields of cotton are obtained. If cultivated, this soil is slightly susceptible to water erosion. (Capability unit IIe-2; Deep Hardland range site)

La Casa-Ector complex (Lc). —This complex is about 70 percent La Casa clay loam; 24 percent Ector soils; and minor areas of Weymouth clay loam, Tillman clay loam, and Hollister clay loam. La Casa clay loam occurs in gently sloping, concave areas, and the Ector soils on moderately sloping, convex ridges and knolls. These soils occupy the uplands in the western part of the county (fig. 18.)

Figure 18.—**Area of the La Casa-Ector complex.**

The La Casa soil in places has a darker colored and thicker surface layer and subsoil than is normal for soils of the La Casa series.

The La Casa soil of this complex is suitable for cultivation but is so intricately associated with the Ector soils, in such small acreages, that cultivating it is impractical. Almost all of this complex has remained as rangeland.

La Casa clay loam is in capability unit IIe-2 and in the Deep Hardland range site. The Ector soils are in capability unit VIIs-1 and in the Very Shallow range site.

Loamy Alluvial Land (Lo)

This land type consists of deep, nearly level soils on the bottom lands. These soils ordinarily occur along the narrow creeks that drain areas of the Abilene, Hollister, Tillman, and Vernon soils. They are dissected by meandering streams (fig. 19) and are flooded frequently.

These soils formed mainly in loamy sediments derived from the red beds. The surface layer is predominantly clay loam, but very fine sandy loam, silt loam, and clay occur in places. The subsoil is stratified and has a wide range in texture.

Figure 19.—Area of Loamy alluvial land.

Few areas, if any, are suitable for cultivation. Most of the acreage is in native mid and tall grasses. (Capability unit Vw-1; Loamy Bottomland range site)

Miles Series

The Miles series consists of deep, brown to reddish-brown, well-drained soils on the uplands. These soils are nearly level to moderately sloping, and for the most part they occur in the northern and eastern parts of the county.

The surface layer has a granular structure and is either fine sandy loam or loamy fine sand. Where the surface layer is fine sandy loam, it is about 8 inches thick (fig. 20), is slightly hard when dry, and is very friable when moist. Where the surface layer is loamy fine sand, it is about 14 inches thick and is loose when dry and moist.

The subsoil is red to reddish-brown sandy clay loam and is about 40 inches thick. It has prismatic and subangular blocky structure but breaks easily into fine granules. Moisture and roots penetrate this layer easily. The lower part is more sandy and lighter colored with increasing depth.

The parent material is sandy outwash or ancient alluvium.

Variations in the profile are common. The fine sandy loam surface layer ranges from 4 to 12 inches in thickness, and the loamy fine sand, from 8 to 20 inches. The subsoil ranges from 28 to 50 inches in thickness. Most areas that have the loamy fine sand surface layer are underlain by a dark-brown, buried soil at a depth of about 35 inches.

Miles soils have a finer textured subsoil than Springer soils. They are deeper and have sandier parent material than Cobb soils. They have a sandier surface layer and a less clayey and more friable subsoil than Altus soils.

Miles soils are among the better soils for dryland farming in Foard County. They absorb and utilize moisture well; consequently, they are well suited to most of the crops commonly grown. The main cultivated crops are cotton, alfalfa, wheat, and grain sorghum. The present rangeland vegetation is mid and tall grasses.

Miles loamy fine sand, 0 to 3 percent slopes (MmB).—This nearly level and gently sloping soil is the most extensive of the Miles soils. Included in the areas mapped are small areas of Springer loamy fine sand, undulating. This inclusion makes up about 4 percent of the acreage, but it is used and managed like this Miles soil.

This soil absorbs water readily; little runoff occurs, even after heavy rains. The surface layer is low in natural fertility.

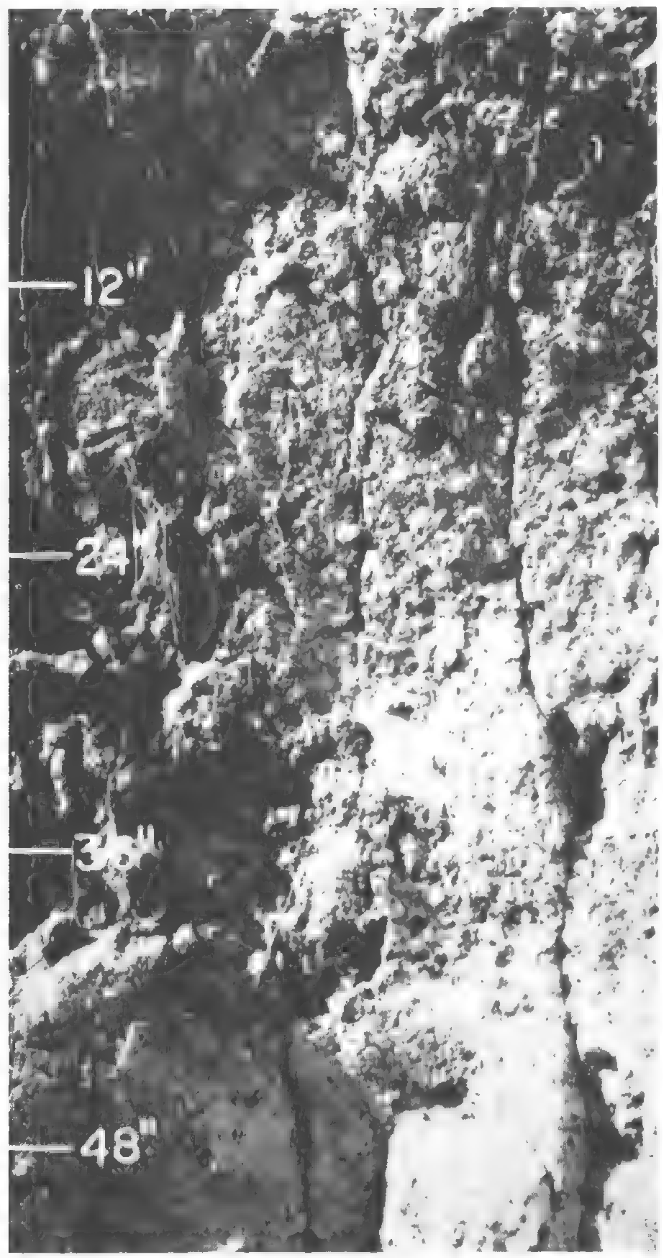

Figure 20.—Profile of Miles fine sandy loam.

Except for a few small tracts, most of this soil is cultivated. It is used mainly for cotton, alfalfa, and grain sorghum.

Unless protected, this coarse-textured soil is highly susceptible to wind erosion. In some areas a few small sandy mounds have formed. Along most of the fences on property lines, the accumulations are as much as 6 feet thick. Although erosion ordinarily has been only slight, it has removed practically all of the surface layer in a few, small areas.

Most areas of this soil have been plowed to a depth of 18 to 26 inches. This deep plowing turns up the moderately fine textured subsoil, which forms clods and thus provides some protection against erosion. If this soil is winnowed after deep plowing, however, it is even more susceptible to wind erosion. (Capability unit IIIe–6; Sandy Land range site)

Miles fine sandy loam, 0 to 1 percent slopes (MfA).—This soil has milder slopes and a thinner, finer textured surface layer than Miles loamy fine sand, 0 to 3 percent slopes. Included in the areas mapped are small areas of Abilene clay loam, 0 to 1 percent slopes; Altus fine sandy loam; Miles fine sandy loam, 1 to 3 percent slopes; and Miles loamy fine sand, 0 to 3 percent slopes. These inclusions make up about 5 percent of the acreage but are of such small size that they do not significantly affect management.

This nearly level, moderately coarse textured soil is one of the better soils for dryland farming. Practically all of it is cultivated. The main crops are cotton, wheat, alfalfa, and grain sorghum.

Unless protected, this soil is slightly susceptible to wind erosion. In some cultivated areas wind has removed some of the silt, clay, and sand and left this soil sandier than it was before it was plowed. (Capability unit IIe–4; Sandy Loam range site)

Miles fine sandy loam, 1 to 3 percent slopes (MfB).—Most areas of this gently sloping soil occur along low ridges that parallel the Pease River. The slope averages about 1.8 percent. In some areas the surface layer is only 4 or 5 inches thick. Some areas are limy. Included in the areas mapped are small areas of Miles loamy fine sand, 0 to 3 percent slopes; and Miles fine sandy loam, 0 to 1 percent slopes. These inclusions make up as much as 6 percent of the acreage but are in areas so small that they do not significantly affect management.

Except for some small tracts along drainageways or areas not easily reached, most of this soil is cultivated. The main crops are cotton, wheat, grain sorghum, and alfalfa.

Unless protected, this moderately coarse textured soil is slightly susceptible to wind and water erosion. A few shallow gullies have formed; these are 4 to 8 inches deep and 2 to 10 feet wide. In some cultivated areas wind has removed some of the silt, clay, and sand and left this soil sandier than it was before it was plowed. (Capability unit IIe–5; Sandy Loam range site)

Miles fine sandy loam, 3 to 5 percent slopes (MfC).—This soil has moderate convex slopes averaging about 4 percent. It generally occurs on narrow ridges and along drainageways within broader areas of Miles fine sandy loam, 1 to 3 percent slopes, and as the areas are mapped, about 4 percent of the acreage consists of that soil. In most places the surface layer is only about 4 inches thick. Some areas are limy.

About 60 percent of the acreage has remained as rangeland. The cultivated areas are used mainly for small grain and sudangrass.

In most places this soil is not eroded. In places, however, part of the original surface layer has been removed. Also, there are areas, even in the rangeland, where this soil has been eroded to the extent that shallow gullies have formed along most of the drainageways. In cultivated areas gullies 6 to 14 inches deep and 6 to 14 feet wide occur in some places. (Capability unit IIIe-4; Sandy Loam range site)

Miller Series

In the Miller series are reddish-brown, deep, moderately well drained soils less extensive than other bottom-land soils in the county.

The surface layer is reddish-brown clay loam or clay. It is about 12 inches thick, is of subangular blocky to blocky structure, and is hard when dry but friable to firm when moist. In most places there are threads and films of accumulated lime.

The subsoil, which extends to a depth of several feet, is reddish-brown clay. It has a blocky structure. The blocks are very hard when dry and very firm when moist. Roots, moisture, and air move very slowly through this layer. Like the surface layer, it contains threads and films of accumulated lime in most places.

The substratum consists of calcareous, stratified layers of alluvium that differ widely in texture.

The surface layer is noncalcareous in some places, and it ranges from 10 to 30 inches in thickness. In places the subsoil is stratified with thin lenses of clay loam, silty clay loam, or light clay.

Miller soils have a more clayey and less friable subsoil than Spur soils.

Miller soils are best suited to small grains and native grasses. The main cultivated crop is wheat. The present rangeland vegetation is short grasses.

Miller clay (Mr).—This nearly level soil occurs in weakly concave areas. Included in the areas mapped are small areas of Spur clay loam. This inclusion makes up about 4 percent of the acreage but does not significantly affect the yields, use, or management of this soil.

This soil is droughty and is used mainly as range. The small areas that are cultivated are used for wheat.

Roots, moisture, and air move very slowly through this soil. In areas that have been overgrazed, regrowth of vegetation is slow. (Capability unit IIIs–1; Clay Flats range site)

Quinlan Series

The Quinlan series consists of reddish-brown, friable, shallow soils on the uplands.

The surface layer is red to reddish-brown, friable fine sandy loam about 6 inches thick and of granular structure.

The subsoil, to a depth of about 12 inches, also is red to reddish-brown, friable fine sandy loam. Ordinarily, it does not contain an accumulation of lime. Roots, water, and air move through this layer easily.

The parent material is weathered from sandstone of the

Permian red beds. This sandstone crops out throughout the areas of Quinlan soils.

Variations occur within the profile. The surface layer ranges from 3 to 6 inches in thickness, and the subsoil, from 1 to 11 inches. Depth to the parent material generally ranges from 6 to 17 inches.

In Foard County Quinlan soils are mapped only with Cobb soils. They are less clayey in the subsoil than Cobb soils but are sandier throughout than Vernon-Weymouth soils.

Quinlan soils are droughty and are low in both organic-matter content and plant nutrients. Because they are shallow, have steep slopes, and contain outcrops of sandstone, these soils are not suitable for cultivation.

Randall Series

The Randall series consists of nearly level, dark-gray, deep, poorly drained soils on the uplands. These soils occur in weakly concave depressions and are not extensive in this county.

The surface layer is dark gray to very dark gray clay. It is about 6 inches thick, is of subangular blocky structure, and is very hard when dry and firm when moist. In most places it is calcareous.

The subsoil is gray to dark-gray, calcareous, blocky clay that extends to a depth of several feet. It contains many nodules of lime. This layer is very hard when dry and very firm when moist. Roots and moisture move very slowly through it.

The underlying material is calcareous, clayey outwash or ancient alluvium.

In this county Randall soils are very uniform; variations in the profile are not common. In places, however, the surface layer is noncalcareous.

Randall soils are more grayish, less friable, and more clayey in the surface layer and subsoil than Abilene soils. They are more grayish, less friable, and more clayey in the surface layer than Hollister soils.

Randall soils can be cultivated successfully except during years of high rainfall. Small grain and grain sorghum are the cultivated crops commonly grown. The present rangeland vegetation is short grasses.

Randall clay (Ra).—This is a nearly level, poorly drained, and seasonally wet soil. Included in the areas mapped are small areas of Abilene clay loam, 0 to 1 percent slopes. This inclusion makes up approximately 2 percent of the acreage, but it is used like this Randall soil.

Wheat is the main crop. Good yields are obtained in dry seasons, but yields are often low in wet seasons. About 40 percent of the acreage has remained as rangeland.

This soil is difficult to farm. If it is too wet when cultivated, the plow layer forms hard clods that are difficult to crush. Runoff from the surrounding areas during spring and fall generally delays planting and occasionally necessitates replanting. (Capability unit IVw-1; Deep Hardland range site)

Sandy Alluvial Land (Sa)

Sandy alluvial land is a miscellaneous land type consisting of mixed sandy alluvium that was deposited erratically along the Pease and Wichita Rivers. The texture of the surface layer is dominantly loamy fine sand and fine sandy loam, but textures of very fine sandy loam, silt loam, or clay occur within short distances. Areas of this land type are undulating and form narrow ridges and valleys parallel to the river channels (fig. 21). Fresh alluvial sediments are deposited once or twice during a 3-year period. The rivers meander across the alluvium, and large areas are completely reworked from time to time. The surface layer contains a considerable amount of salt, as shown by the thick overstory of saltcedar. (Capability unit Vw-2; Sandy Bottomland range site)

Figure 21.—**Area of Sandy alluvial land.**

Springer Series

The Springer series consists of brown to reddish-brown, deep, well-drained soils on the uplands. Most areas of these soils occur near Thalia, but there are a few small areas north of Margaret.

The surface layer is light-brown to light reddish-brown, structureless loamy fine sand. It is about 16 inches thick and is loose when dry and moist.

The subsoil is a reddish-brown, granular fine sandy loam about 20 inches thick. It is porous and absorbs water readily. Ordinarily, there is no accumulated lime in this layer.

The substratum consists of sandy outwash or ancient alluvium (fig. 22).

The surface layer ranges from 12 to 26 inches in thickness, and the subsoil, from 18 to 55 inches In most places there is a dark-brown, buried soil 30 to 48 inches below the surface.

Springer soils have a more friable and less clayey subsoil than Miles soils. They are less sandy throughout than Tivoli soils.

These soils are used mainly for cotton, grain sorghum, and alfalfa. They have a good supply of soil moisture.

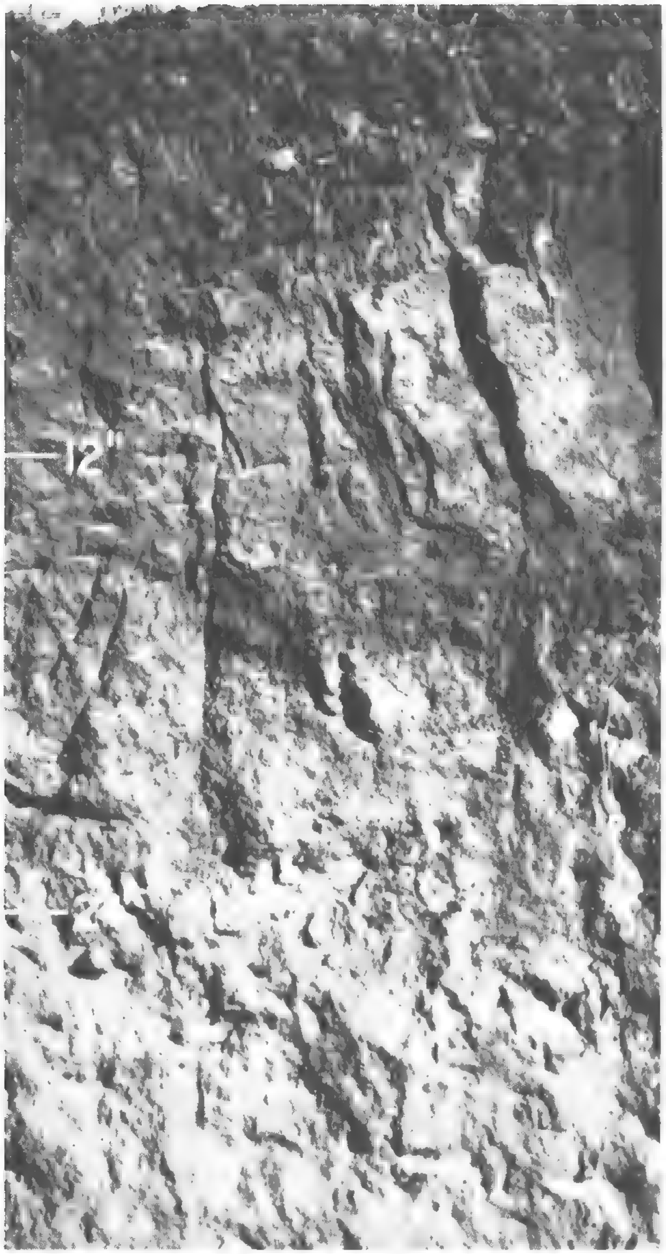

Figure 22.—**Profile of Springer loamy fine sand.**

Frequent fertilization is required to replenish plant nutrients. Only a few areas remain as rangeland, and these support mid and tall grasses.

Springer loamy fine sand, undulating (Sg).—This soil is nearly level and gently sloping and in most places has a wavelike, uneven surface. Included in the areas mapped are hummocky areas that are otherwise identical with this soil, some small areas of Miles loamy fine sand, 0 to 3 percent slopes, and areas of Enterprise fine sandy loam, 1 to 3 percent slopes. These inclusions make up about 6 percent of the acreage but do not significantly affect use and management of this soil.

Unless protected, this soil is highly susceptible to wind erosion. Erosion has been only slight on most of the acreage, but it has removed most of the surface layer in a few places. In many places a few small sandy mounds have formed. Along most of the fences on property lines, the accumulations are as much as 6 feet thick.

Little runoff occurs, even after heavy rains. Ordinarily, both the organic-matter content and the supply of available plant nutrients are low. The main crops are cotton and alfalfa. (Capability unit IVe–2; Sandy Land range site)

Springer loamy fine sand, hummocky (Sp).—This soil is moderately sloping to sloping. The slope averages about 4 percent. The surface layer ordinarily is about 12 inches thick. Included in the areas mapped are undulating areas, otherwise identical with this soil, that make up about 2 percent of the acreage.

Unless protected, this soil is highly susceptible to wind erosion. Erosion has been only slight on most of this soil, but it has removed most of the surface layer in a few places. The soil has a low organic-matter content and is low in available plant nutrients. The main crops are cotton and grain sorghum. (Capability unit VIe–1; Sandy Land range site)

Spur Series

The Spur series consists of reddish-brown to brown, deep, well-drained soils on the bottom lands. These soils occur along the Wichita and Pease Rivers and most of the small tributaries.

The surface layer is reddish brown to dark brown. It is about 20 inches thick, is of granular structure, and is slightly hard when dry and very friable when moist. In most places it is calcareous. Ordinarily, it is easy to till and to work into a good seedbed.

The subsoil, to a depth of several feet, is reddish-brown to dark-brown light silty clay loam. It has a granular structure and is slightly hard when dry but very friable when moist. Roots penetrate this layer easily. In most places there are threads and films of accumulated lime.

The underlying material consists of calcareous stratified layers of alluvium that differ widely in texture (fig. 23).

The surface layer is either silt loam or clay loam in texture, ranges from 10 to 24 inches in thickness, and is noncalcareous in some places. The subsoil is stratified with lenses of clay and of very fine sandy loam in places.

Spur soils have a more friable and less clayey subsoil than Miller soils. They have a less sandy subsoil than Yahola soils.

Spur soils ordinarily absorb water readily; there is no runoff other than that occurring during very heavy rains. These soils are well suited to most of the crops and grasses commonly grown in the area. The present rangeland vegetation is mid and tall grasses.

Spur clay loam (Su).—This nearly level, moderately fine textured soil is in weakly concave areas. Included in the areas mapped are small areas of Miller clay loam and Spur silt loam. These inclusions make up as much as 5 percent of the acreage, but they are small and do not significantly affect use and management of this soil.

Although this is one of the better soils in the county, only small acreages of it have been cultivated. Most of it occurs on large ranches and is used as range. If cultivated, it is used for wheat and grain sorghum. (Capability unit I–1; Loamy Bottomland range site)

Spur silt loam (Sr).—This medium-textured soil has nearly level, weakly convex slopes that average about

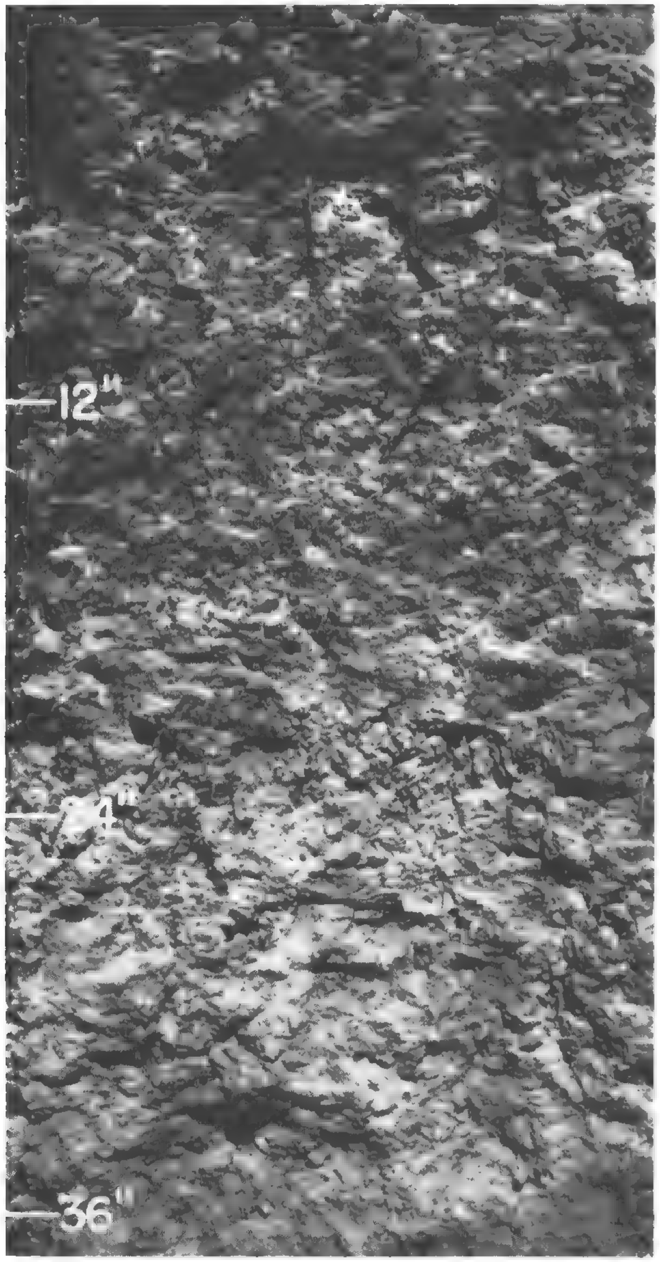

Figure 23.—Profile of Spur clay loam.

0.7 percent. Included in the areas mapped are small areas that are identical with this soil but have slopes of 1 to 3 percent and small areas of Yahola very fine sandy loam and Spur clay loam. These inclusions make up about 6 percent of the acreage but are small and do not significantly affect use and management of this soil.

Except for a few small areas on some of the large ranches, practically all of this soil is cultivated. It is one of the highly productive soils in the county. It absorbs moisture readily, and its surface layer has good tilth.

This soil is well suited to cotton, small grain, and grain sorghum. Alfalfa is grown on many areas. In most years it is adversely affected by midsummer droughts. It may yield a late fall cutting if rains occur in September. (Capability unit I–1; Loamy Bottomland range site)

Spur and Miller clay loams (Sy).—These nearly level soils occur in weakly concave areas along most of the small streams in the southern part of the county. The Spur soil makes up about 60 percent of the acreage. The Miller soil, which is not mapped separately in this county but is described under "Miller Series," makes up about 40 percent of the acreage. Although these soils differ in their composition, they occur in such complex patterns that for practical purposes they are shown as one mapping unit.

Included in the areas mapped are small areas identical with the Miller soil except in texture, and small areas of Loamy alluvial land. These inclusions make up approximately 5 percent of the acreage but are small and thus are used and managed like these Spur and Miller clay loams.

Because these soils are nearly level, they are easy to cultivate. In most places they can be worked into a good seedbed, but in some places they have poor structure and their surface tends to crust. When these soils are cultivated, the main crop is wheat. About 80 percent of the acreage is in large ranches and is used as range. Both soils are in capability unit IIc–1. The Spur soil is in the Loamy Bottomland range site, and the Miller soil is in the Deep Hardland range site.

Tillman Series

The Tillman series consists of reddish-brown to brown, deep soils on the uplands. These soils are widely distributed throughout the southern and western parts of the county.

The surface layer is reddish-brown to brown clay loam. It is ordinarily about 5 inches thick, is of a subangular blocky structure, and is hard when dry but friable when moist.

The subsoil, which extends to a depth of about 40 inches, is reddish-brown clay of blocky structure. The blocks are very hard when dry and very firm when moist. Nodules of lime have accumulated in the lower part. Moisture, air, and roots move through this layer very slowly.

The parent material, to a depth of 4 feet or more, is calcareous clay and shale of the Permian red beds (fig. 24).

Minor variations occur within the profile. The surface layer ranges from 3 to 7 inches in thickness, and in a few places it is calcareous. The thin transitional layer between the surface layer and the subsoil is absent in places. Depth to the layer of accumulated lime ranges from 28 to 50 inches.

Tillman soils have a redder surface layer and subsoil than Hollister soils. They are lighter colored in the surface layer and more clayey in the subsoil than La Casa soils. They have a thicker surface layer and subsoil than Vernon soils.

Tillman soils are ordinarily high in plant nutrients but are not highly productive because they are droughty. The main cultivated crops are wheat, grain sorghum, and cotton. The present range vegetation is short grasses.

Tillman clay loam, 0 to 1 percent slopes (TcA).—This nearly level soil is less extensive than Tillman clay loam, 1 to 3 percent slopes. Included in the areas mapped are small areas of Abilene clay loam, 0 to 1 percent slopes; Hollister clay loam, 0 to 1 percent slopes; and Vernon-

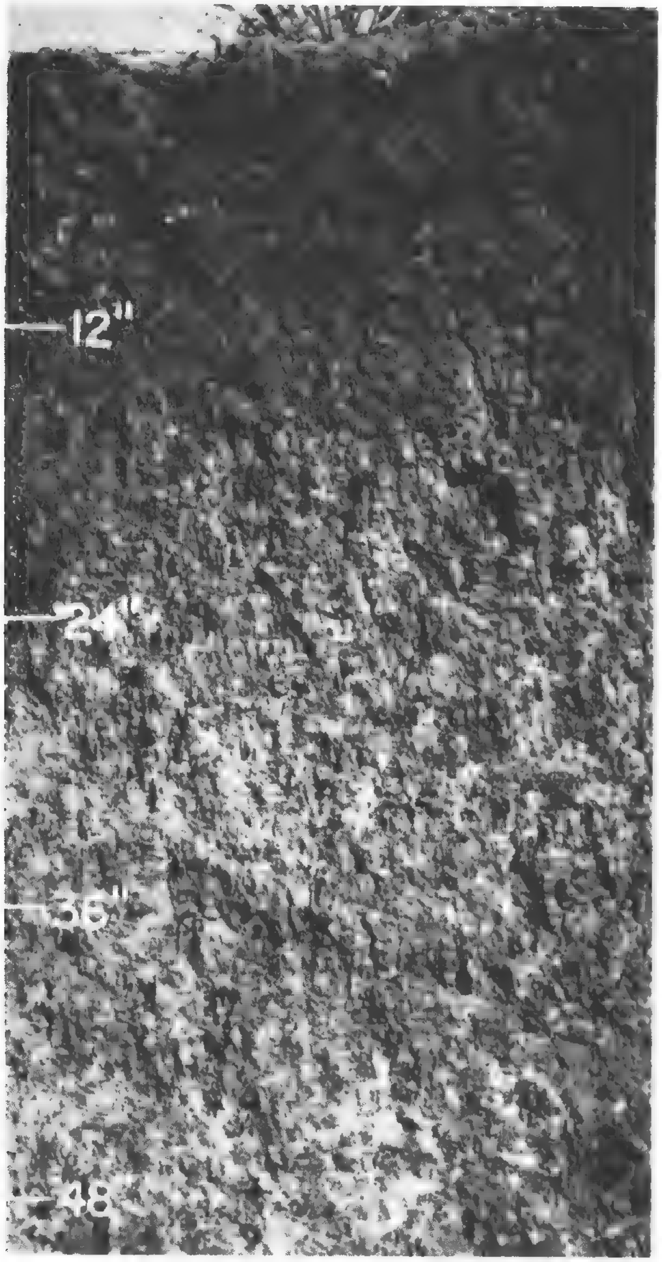

Figure 24.—Profile of Tillman clay loam.

Weymouth clay loams, 1 to 3 percent slopes. These inclusions make up about 6 percent of the acreage, but they are small and are used and managed like this Tillman soil.

This soil is easy to till and shows few signs of erosion. Only about 30 percent of it has been cultivated because the largest acreage is in large ranches and is used as range. When cultivated, it is used mainly for wheat. (Capability unit IIs-1; Deep Hardland range site)

Tillman clay loam, 1 to 3 percent slopes (TcB).—This soil has gentle convex slopes averaging almost 2 percent and occurs on divides along the larger drainageways. It is the most extensive of the Tillman soils.

Included in the areas mapped are small areas that are identical with this soil but nearly level, and small areas of Hollister clay loam, 1 to 3 percent slopes; Abilene clay loam, 1 to 3 percent slopes; Vernon-Weymouth clay loams, 1 to 3 percent slopes; and Spur clay loam. These inclusions make up as much as 8 percent of the acreage. They differ in management required but are too small to be mapped separately.

About 60 percent of this soil has remained as rangeland. Wheat, cotton, and grain sorghum are the main cultivated crops. In cultivated areas, the effects of water erosion are noticeable along shallow drains. The surface layer has been thinned 2 to 3 inches through sheet erosion in some places, and a few shallow gullies have formed that are 4 to 10 inches deep and 2 to 15 feet wide. (Capability unit IIIe-1; Deep Hardland range site)

Tillman clay loam, 1 to 3 percent slopes, eroded (TcB2).—This soil occupies gently sloping surfaces along shallow drains. As a result of water erosion, gullies 8 to 20 inches deep and 8 to 20 feet wide have formed. Included in the areas mapped are areas of Vernon-Weymouth clay loams, 1 to 3 percent slopes, which make up about 5 percent of the acreage, and a few small areas that have retained most of the original Tillman surface layer.

This soil has been eroded to the extent that only an inch or two of the original surface layer remains, and in several areas the subsoil is exposed 200 feet back on both sides of the drains. Several rills or shallow gullies have formed on the side slopes of the drains (fig. 25). Almost all of this soil is cultivated; it is used for wheat or other small grain. (Capability unit IVe-1; Deep Hardland range site)

Figure 25.—Typical area of Tillman clay loam, 1 to 3 percent slopes, eroded.

Tipton Series

The Tipton series consists of nearly level, deep, dark-colored, friable soils. These soils occur along the low terraces of the Pease River.

The surface layer is brown to very dark grayish-brown, granular silt loam. It is about 8 inches thick and is slightly hard when dry and very friable when moist.

The subsoil, to a depth of about 28 inches, is dark-brown to dark grayish-brown loam or clay loam. The subangular blocks break into fine granules very easily. In some places lime has accumulated in this layer.

The substratum consists of moderately fine textured outwash or ancient alluvium.

Variations in the profile are uncommon, but they do occur in some places. The surface layer ranges from 5 to 10 inches in thickness, and the subsoil, from 14 to 34 inches. In places there is a very dark grayish-brown, buried soil about 30 to 40 inches from the surface.

Tipton soils are darker colored and less sandy than Miles soils. They have a less clayey subsoil than Altus soils and are darker colored and more clayey than Enterprise soils.

Tipton soils are the most suitable soils for cultivating in the county and are well suited to most of the crops and grasses commonly grown. Cotton, wheat, and alfalfa are the main crops.

Tipton silt loam (Tp).—This nearly level soil is fertile and highly productive. In a few areas the surface texture of this soil is fine sandy loam. Also included in the areas mapped are areas of Enterprise very fine sandy loam, 0 to 1 percent slopes, which make up a small percentage of the acreage.

Except for a few small field corners that are inaccessible, practically all of this soil is cultivated. Because it is nearly level, it absorbs most of the rainfall. Generally, it can be tilled easily and worked into an exceptionally good seedbed. This soil ordinarily has a high content of organic matter and is well supplied with available plant nutrients. (Capability unit IIc–2; Mixed Land range site)

Tivoli Series

The Tivoli series consists of excessively drained, light-colored, sandy soils on the uplands. These soils form dunes that are adjacent to the Pease River (fig. 26). For the most part, they are in the northeastern part of the county.

Figure 26.—Area of Tivoli fine sand.

The surface layer is light-brown to yellowish-red, loose fine sand. It ordinarily is calcareous and about 8 inches thick.

The underlying parent material consists of windlaid, coarse-textured sediments, probably blown from riverbeds. Ordinarily, it is several feet thick.

In some areas the surface layer is noncalcareous. It ranges from 6 to 14 inches in thickness.

Tivoli soils have a sandier surface layer and subsoil than Miles, Springer, and Enterprise soils.

Tivoli soils are used almost entirely as range. The present vegetation is mid and tall grasses, sand sagebrush, and shin oak.

Tivoli fine sand (Tv).—This soil is gently sloping to sloping and hummocky. The slope averages about 5 percent. Included in the areas mapped are small areas of Enterprise fine sandy loam, 1 to 3 percent slopes, which make up about 2 percent of the acreage. These included areas have better capacity to produce forage but are too small to be mapped separately.

This soil is very low in organic-matter content and available plant nutrients. It absorbs most of the rainfall; little runoff occurs, even during heavy rains. If overgrazed, this soil is highly susceptible to wind erosion. (Capability unit VIIe–1; Deep Sand range site)

Vernon Series

The Vernon series consists of reddish, calcareous, shallow and very shallow soils on the uplands. These soils are widely distributed throughout the county.

The surface layer is reddish-brown to brown, calcareous clay loam or clay. It is about 5 inches thick, is of subangular blocky structure, and is friable when moist.

The subsoil, to a depth of about 10 inches, is reddish-brown to yellowish-red clay or clay loam. It is very hard when dry but firm when moist. In most places it contains accumulations of lime. Roots, moisture, and air generally move slowly through this layer.

The parent material is red to reddish-brown, calcareous clay and shale of the Permian red beds.

Within short distances, variations occur in the thickness of the surface layer and subsoil. Depending upon the degree of erosion, the surface layer ranges from 2 to 6 inches in thickness. The thickness of the subsoil varies between 4 and 15 inches, and the texture, between light clay and clay.

Vernon soils are more shallow than Tillman soils. They are more clayey, are less friable, and contain less lime in the subsoil than Weymouth soils. They are more clayey in the surface layer and subsoil than Cobb soils.

Vernon soils are droughty and are ordinarily low in organic-matter content and plant nutrients. They are used largely as rangeland. The small cultivated areas are used for small grain and sudangrass. The present rangeland vegetation is short grasses.

Vernon-badland complex (Vb).—This complex is gently sloping and sloping. The slope averages about 4 percent. About 55 percent of the acreage is Vernon clay loam, and 40 percent is badlands. The remaining 5 percent consists of Tillman clay loam and Weymouth clay loam. Vernon clay loam occupies the higher ridges and knolls, and the badlands, the lower lying eroded spots or escarpments (fig. 27).

Figure 27.—**Area of Vernon-badland complex.**

Practically all of this complex is used as range. The Vernon soil could be cultivated, but it occurs in such small areas that cultivation is impractical. If cultivated or left unprotected, it is moderately susceptible to water erosion. In most places the badland outcrops lack surface soil; they are highly erodible and support only a scant growth of short grasses. They are described under "Badland."

Vernon clay loam is in capability unit IVe–3 and in the Shallow Redland range site. Badland is in capability unit VIIIs–1 and is not assigned to a range site.

Vernon-Weymouth clay loams, 1 to 3 percent slopes (VcB).—This complex has gentle, convex slopes. In some places it occurs as small ridges or knolls, but generally it is along drainageways.

This complex is about 45 percent Vernon clay loam and 40 percent Weymouth clay loam. Minor areas of the Tillman, Hollister, Abilene, and La Casa clay loams, all of which have slopes of 1 to 3 percent, and small areas of red-bed outcrops and of Loamy alluvial land account for the remaining 15 percent. All of these soils occur in such a complex pattern that for practical purposes they are shown as one mapping unit.

Vernon clay loam is somewhat similar to the soils described in "Vernon Series." The Weymouth soil is described in "Weymouth Series." Neither soil is mapped separately in this county.

About 30 percent of this complex is cultivated. The main crops are oats, barley, and sudangrass. Because the soils are droughty and low in natural fertility, they are not highly productive. Unless protected, they are moderately susceptible to erosion.

Both soils are in capability unit IVe–3. Vernon clay loam is in the Shallow Redland range site, and Weymouth clay loam is in the Deep Hardland range site.

Vernon-Weymouth clay loams, 3 to 5 percent slopes (VcC).—This complex is moderately sloping and in most places occurs along drainageways. It is about 50 percent Vernon clay loam; 35 percent Weymouth clay loam; and 15 percent Tillman soils, red-bed outcrops, and Loamy alluvial land. In some places as much as 20 percent is red-bed outcrops.

The thickness of the surface layer and subsoil of Vernon clay loam is about 10 inches. Otherwise, this soil is similar to the soils described in "Vernon Series." The Weymouth soil is described in "Weymouth Series."

Because of the slope, the soils of this complex are moderately susceptible to water erosion if they are cultivated and left unprotected. Now, small acreages are cultivated, and they are used mainly for oats or sudangrass.

Both soils are in capability unit VIe–2. Vernon clay loam is in the Shallow Redland range site, and Weymouth clay loam is in the Deep Hardland range site.

Weymouth Series

The Weymouth series consists of brown to reddish-brown, friable, strongly calcareous soils on the uplands.

The surface layer is reddish-brown to brown granular clay loam. It is about 6 inches thick and is slightly hard when dry but friable when moist.

The subsoil is reddish-brown friable clay loam. It is about 8 inches thick and is of subangular blocky structure but breaks easily into small granules. Roots, moisture, and air penetrate this layer easily. In most places this layer contains accumulated nodules of lime. It ordinarily overlies a thin layer that is very strongly calcareous and contains many nodules of lime.

The parent material is calcareous and clayey, predominantly clay and shale of the Permian red beds.

Variations are common. The surface layer ranges from 3 to 7 inches in thickness and from weakly to strongly calcareous in reaction. The subsoil ranges from 6 to 15 inches in thickness. In some places the layer of lime is thin and indistinct, but in other places it is thick bedded. Depth to the parent material ranges from 14 to 30 inches.

In this county Weymouth soils are mapped only with Vernon soils. They are less clayey and more friable in the subsoil than Vernon soils. They are lighter colored and more shallow than La Casa soils and less sandy than Cobb soils.

Weymouth soils are droughty and generally are low in organic-matter content and plant nutrients.

Wichita Series

The Wichita series consists of nearly level and gently sloping, brown to reddish-brown, friable soils on the uplands. These soils are in the central part of the county.

The surface layer is brown to reddish-brown loam or clay loam. It is ordinarily about 6 inches thick, of granular structure, and very friable when moist.

The subsoil is reddish-brown to dark reddish-brown, blocky heavy clay loam. The blocks break easily into fine granules. This layer is about 38 inches thick, is hard when dry but friable when moist, and in most places contains an accumulation of lime in the lower part. Generally, roots, moisture, and air move slowly through this layer.

The underlying material is calcareous outwash or ancient alluvium, largely of the Permian red beds (fig. 28).

Variations occur within the profile. The texture of the surface layer varies between loam and clay loam, and the thickness, between 4 and 7 inches. The texture of the subsoil varies between clay loam and light clay, and the thickness, between 25 and 48 inches. In some places there is no accumulation of lime in this layer.

Wichita soils have a less sandy surface layer and finer textured subsoil than Miles soils. They are lighter colored

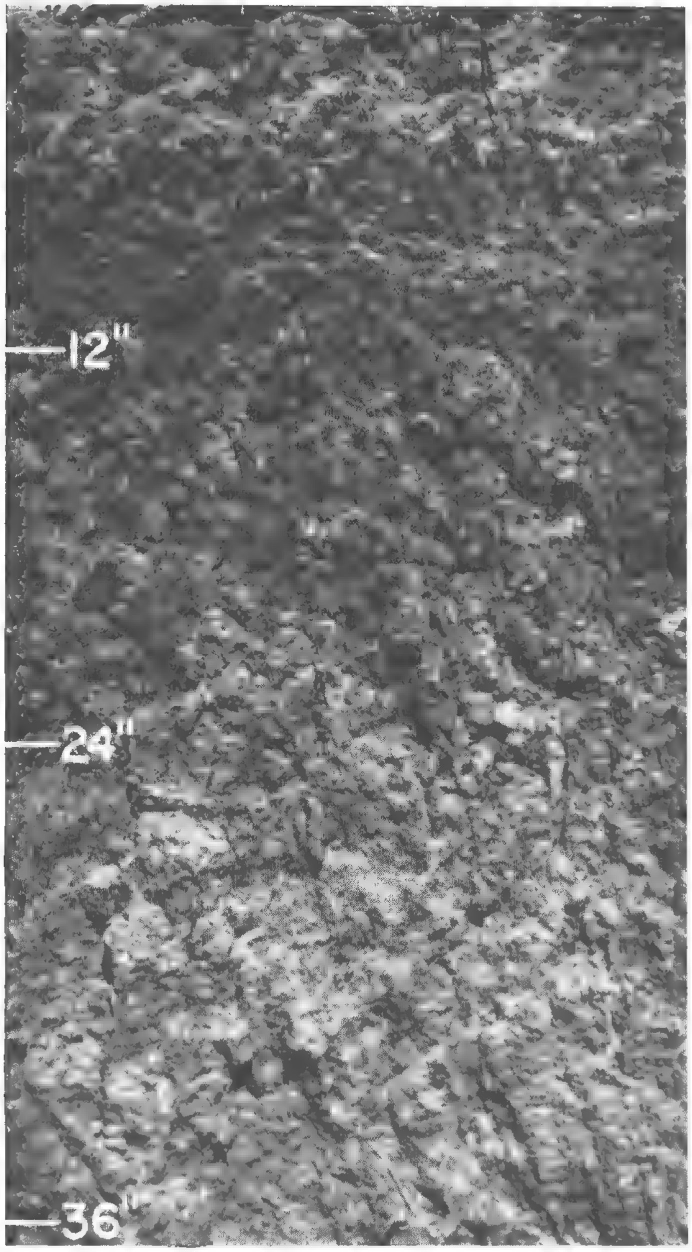

Figure 28.—**Profile of Wichita loam.**

throughout than the Abilene soils and are more clayey in both the surface layer and subsoil than Cobb soils.

Wichita soils are used mainly for cotton, wheat, and grain sorghum. They have a moderately high content of organic matter and a good supply of plant nutrients. The rangeland vegetation is short and mid grasses.

Wichita loam, 0 to 1 percent slopes (WmA).—This medium-textured soil has nearly level, convex slopes. It is the most extensive of the Wichita soils.

Included in the areas mapped are small areas of Miles fine sandy loam, 0 to 1 percent slopes; Vernon-Weymouth clay loams, 1 to 3 percent slopes; Cobb fine sandy loam, 1 to 3 percent slopes; and a soil that is identical with this Wichita soil except for 1 to 3 percent slopes. These inclusions make up about 5 percent of the total acreage but do not significantly affect the use and management of this soil.

This is one of the better soils in the county for dryland farming. Almost all of it is cultivated, except for small areas where cultivation is impractical. The main crops are cotton, wheat, and grain sorghum. Yields are moderately high if rainfall is plentiful. (Capability unit IIc-1; Deep Hardland range site)

Wichita loam, 1 to 3 percent slopes (WmB).—This soil has convex slopes averaging about 1.9 percent. For the most part, it occurs on a high ridge between Raggedy and Blacks Branch Creeks. Included in the areas mapped are small areas of Tillman clay loam, 1 to 3 percent slopes; Cobb fine sandy loam, 1 to 3 percent slopes; and Wichita loam, 0 to 1 percent slopes. These inclusions make up about 4 percent of the acreage but are small and are used like this Wichita soil.

About 50 percent of the acreage is cultivated. The main crops are cotton, wheat, and grain sorghum. If cultivated and left unprotected, this soil is slightly susceptible to water erosion. In some places a few shallow gullies have formed; these are 4 to 8 inches deep and 2 to 12 feet wide. There are also places where sheet erosion has removed 2 to 3 inches of the surface layer. (Capability unit IIe-1; Deep Hardland range site)

Wichita clay loam, 1 to 3 percent slopes (WcB).—This soil has gentle, convex slopes averaging about 1.8 percent. It occurs on small ridges and narrow bands below the nearly level Wichita loam. Included in the areas mapped are small areas of Wichita loam; Abilene clay loam, 1 to 3 percent slopes; and Vernon-Weymouth clay loams, 1 to 3 percent slopes. These inclusions make up as much as 4 percent of the total acreage. They differ in management required but are too small to be mapped separately.

About 65 percent of the acreage is in large ranches and is used as range. Unless protected, the cultivated areas are slightly susceptible to water erosion. On some of the stronger slopes, the surface layer has been thinned 2 to 3 inches by sheet erosion. The main crop is wheat. (Capability unit IIe-1; Deep Hardland range site)

Yahola Series

The Yahola series consists of brown to yellowish-red, deep, well-drained soils on the bottom lands. These soils occur along the alluvial plains of the Wichita and Pease Rivers.

The surface layer is brown to yellowish red, is of granular structure, is about 24 inches thick, and is slightly hard when dry but very friable when moist. In most places it is calcareous.

The subsoil, extending to a depth of several feet, is reddish yellow, of granular structure, and slightly hard when dry but very friable when moist. It is easily penetrated by roots. In most places threads and films of lime have accumulated in this layer.

The underlying material consists of calcareous, stratified layers of alluvium that differ widely in texture.

In some places the surface layer is noncalcareous. It ranges from 18 to 30 inches in thickness. The texture of the subsoil ranges from very fine sandy loam to fine sandy loam or loamy fine sand.

Yahola soils have a sandier subsoil than Spur soils. Yahola soils are well suited to most of the crops and grasses commonly grown in the area. They absorb water readily;

little runoff occurs even during heavy rains. The present rangeland vegetation is mid and tall grasses.

Yahola very fine sandy loam (Ya).—This soil has nearly level, weakly convex slopes. Included in the areas mapped are areas of Spur silt loam, which make up approximately 4 percent of the total acreage. There are also included areas that have a surface layer of fine sandy loam and other areas that have a coarse, sandy subsoil. Because all of these areas are small, they are used and managed like this Yahola soil.

This is one of the more productive soils in the county. About 50 percent of it is cultivated. The surface layer is very friable. It is easily tilled and prepared as a seedbed. Generally, this soil receives extra moisture as runoff from the surrounding steeper areas, but it is seldom flooded from streams or rivers. It is well suited to cotton, small grain, and grain sorghum. Alfalfa is grown in some areas. On large ranches some areas are used as range. (Capability unit I–1; Loamy Bottomland range site)

Use and Management of the Soils

This section explains the capability classification, in which the soils are grouped according to their suitability for most kinds of farming; defines the capability groups in Foard County; and discusses the management of the soils by capability units. It discusses general management of cultivated soils, gives a brief description of irrigation in the county, and predicts yields of crops on different soils under two levels of management. This section also contains subsections on range management, on field windbreaks, and on engineering uses of the soils.

Capability Groups of Soils

The capability classification is a grouping that shows, in a general way, how suitable soils are for most kinds of farming. It is a practical grouping based on limitations of the soils, the risk of damage when they are used, and the way they respond to treatment.

In this system all the kinds of soil are grouped at three levels, the capability class, subclass, and unit. The eight capability classes in the broadest grouping are designated by Roman numerals I through VIII. In class I are the soils that have few limitations, the widest range of use, and the least risk of damage when they are used. The soils in the other classes have progressively greater natural limitations. In class VIII are soils and landforms so rough, shallow, or otherwise limited that they do not produce worthwhile yields of crops, forage, or wood products.

The subclasses indicate major kinds of limitations within the classes. Within most of the classes there can be as many as four subclasses. The subclass is indicated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* means that water in or on the soil will interfere with plant growth or cultivation; *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c* indicates that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few or no limitations. Class V can contain, at the most, only subclasses *w*, *s*, and *c*, because the soils in it have little or no erosion hazard but have other limitations that limit their use largely to pasture, range, woodland, or wildlife.

Within the subclasses are the capability units, groups of soils enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally identified by numbers assigned locally, for example, IIe–1 or IIIe–2.

Soils are classified in capability classes, subclasses, and units in accordance with the degree and kind of their permanent limitations; but without consideration of major and generally expensive landforming that would change the slope, depth, or other characteristics of the soil; and without consideration of possible but unlikely minor reclamation projects.

The eight classes in the capability system, and the subclasses and units in this county, are described in the list that follows.

Class I. Soils that have few limitations that restrict their use.
- Unit I–1. Deep, well-drained, nearly level soils that have a moderately fine textured or medium-textured surface layer and a friable subsoil.

Class II. Soils that have some limitations that reduce the choice of plants or that require moderate conservation practices.
- Subclass IIe. Soils subject to moderate erosion if they are not protected.
  - Unit IIe–1. Deep, well-drained, gently sloping soils that have a firm, blocky subsoil.
  - Unit IIe–2. Deep, well-drained, gently sloping soils that have a blocky but friable subsoil.
  - Unit IIe–3. Deep, well-drained, gently sloping soils that have a friable, medium-textured surface layer and subsoil.
  - Unit IIe–4. Deep, well-drained, nearly level soils that have a moderately coarse textured surface layer and a moderately fine textured subsoil.
  - Unit IIe–5. Deep, well-drained, gently sloping soils that have a moderately coarse textured surface layer and a moderately fine textured subsoil.
  - Unit IIe–6. Deep, well-drained, nearly level soils that have a moderately coarse textured surface layer and subsoil.
- Subclass IIs. Soils that have moderate limitations of moisture capacity or tilth.
  - Unit IIs–1. Deep, moderately well drained, nearly level soils that have a moderately fine textured surface layer and a fine-textured, compact subsoil that is very slowly drained.
- Subclass IIc. Soils subject to slight climatic limitations or dry climate.
  - Unit IIc–1. Deep, well-drained soils that have a firm, blocky subsoil.
  - Unit IIc–2. Deep, well-drained soils that have a medium-textured surface layer and a friable subsoil.

Class III. Soils that have severe limitations that reduce the choice of plants, or require special conservation practices, or both.

Subclass IIIe. Deep and moderately deep soils subject to slight to severe erosion if they are cultivated and not protected.

Unit IIIe-1. Deep, moderately well drained, gently sloping soils that have a moderately fine textured surface soil and a fine-textured, compact subsoil that has very slow internal drainage.

Unit IIIe-2. Deep, eroded, gently sloping soils that have a firm, blocky subsoil.

Unit IIIe-3. Deep, well-drained, moderately sloping soils that have a thick, friable, medium-textured surface layer and subsoil.

Unit IIIe-4. Deep, moderately sloping soils that have a moderately coarse textured surface layer and a moderately fine textured subsoil.

Unit IIIe-5. Deep, well-drained, gently sloping soils that have a moderately coarse textured surface layer and subsoil.

Unit IIIe-6. Deep, well-drained, nearly level to gently sloping soils that have a coarse-textured surface layer and a moderately fine textured subsoil.

Unit IIIe-7. Moderately deep, well-drained, gently sloping soils that have a moderately coarse textured surface layer and a moderately fine textured subsoil.

Subclass IIIs. Soils that have severe limitations of moisture capacity or tilth.

Unit IIIs-1. Deep, moderately well drained, nearly level soils that have a fine-textured surface layer and subsoil and are very slowly drained.

Unit IIIs 2. Deep, moderately well drained, nearly level soils that have salt spots in the surface layer.

Class IV. Soils that have very severe limitations that restrict the choice of plants, require very careful management, or both.

Subclass IVe. Deep and shallow soils subject to slight to severe erosion if they are cultivated and not protected.

Unit IVe-1. Deep, eroded, gently sloping soils that have a moderately fine textured surface layer and a fine-textured, compact subsoil that is very slowly drained.

Unit IVe 2. Deep, well-drained, nearly level to gently sloping soils that have a coarse-textured surface layer and a moderately coarse textured subsoil.

Unit IVe-3. Shallow, well-drained, gently sloping to moderately sloping soils that have a moderately fine textured or moderately coarse textured surface layer and a moderately fine textured subsoil.

Subclass IVw. Soils that have severe limitations for cultivation, because of excess water.

Unit IVw-1. Deep, nearly level, poorly drained soils that have a fine-textured surface layer and subsoil.

Class V. Soils not likely to erode that have other limitations, impractical to remove without major reclamation, that limit their use largely to pasture or range, or wildlife food and cover.

Subclass Vw. Soils that are restricted in use for cultivated crops by frequent flooding, poor drainage, and salinity.

Unit Vw-1. Deep, wet, saline, poorly drained, loamy soils on the bottom lands.

Unit Vw-2. Deep, wet, poorly drained, sandy soils on the bottom lands.

Class VI. Soils that have severe limitations that make them generally unsuitable for cultivation and that limit their use largely to pasture or range, or wildlife food and cover.

Subclass VIe. Soils severely limited, chiefly by risk of erosion if protective cover is not maintained.

Unit VIe-1. Deep, well-drained, moderately sloping to sloping soils that have a coarse-textured surface layer and a moderately coarse textured subsoil.

Unit VIe-2. Shallow and very shallow, excessively drained, moderately sloping soils that are moderately fine textured and moderately coarse textured.

Subclass VIs. Soils generally unsuitable for cultivation and limited for other uses by moisture capacity and gravel.

Unit VIs-1. Moderately deep, moderately sloping to strongly sloping, gravelly soils.

Class VII. Soils that have very severe limitations that make them unsuitable for cultivation without major reclamation, and that restrict their use largely to grazing or wildlife.

Subclass VIIe. Soils very severely limited, chiefly by risk of erosion if protective cover is not maintained.

Unit VIIe-1. Deep, moderately sloping to sloping soils that have a coarse-textured surface layer and subsoil.

Subclass VIIs. Soils very severely limited by moisture capacity, stones, or other soil features.

Unit VIIs-1. Moderately sloping to steep soils that are stony and contain outcrops of gypsum.

Class VIII. Soils and landforms that, without major reclamation, have limitations that preclude their use for commercial production of plants and that restrict their use to recreation, wildlife, water supply, or esthetic purposes.

Unit VIIIs-1. Gently sloping to steep, raw, clayey soil material.

Management by Capability Units

In the following pages all the soils in Foard County are listed in capability units. The soils in each capability unit are suitable for about the same crops and grasses and need about the same kind of management. Management practices are discussed for groups of soils in the capability units and generally in the section "General Management of Cultivated Soils."

Capability unit I-1

This unit consists of nearly level, brown to yellowish-red soils that are deep and well drained and have a friable subsoil. These soils are—

Spur clay loam.
Spur silt loam.
Yahola very fine sandy loam.

All of these soils are on the bottom lands. They are the most productive soils in the area. They are tilled easily and are penetrated readily by roots, air, and moisture. If they are plowed consistently at the same depth, however, a plowpan forms. The chief hazards in dryland farming are insufficient rainfall and failure to preserve good tilth and maintain fertility.

Almost all of the crops suited to the area can be grown on these soils, but cotton, wheat, and grain sorghum are the main crops. Alfalfa generally is grown, but it does not grow well after midsummer.

A suitable cropping system is one in which wheat, grain sorghum, or a similar high-residue crop is grown 1 year out of 4; a soil-improving crop, such as vetch, 1 year out of 4; and cotton or another crop the rest of the time. This system helps to preserve good tilth and maintain high yields. An alternative cropping system is small grain or another high-residue crop grown continuously for 4 or 5 years, and then alfalfa for about an equal period.

Leaving crop residues on or near the surface helps to control evaporation of moisture and to increase the capacity of the soils to absorb rainfall. By varying the depth of plowing, formation of a plowpan can be controlled. Yields improve if good seed is planted, insects are controlled, and fertilizer is applied according to the needs of the soils and crops.

Capability unit IIe-1

This unit consists of reddish-brown to dark grayish-brown, deep, well-drained, soils that have a firm, blocky subsoil. These soils are—

Abilene clay loam, 1 to 3 percent slopes.
Hollister clay loam, 1 to 3 percent slopes.
Wichita clay loam, 1 to 3 percent slopes.
Wichita loam, 1 to 3 percent slopes.

These soils are well supplied with available plant nutrients and are easy to cultivate and to work into a good seedbed. Their moderate susceptibility to water erosion is the chief hazard in dryland farming; after heavy rains, much of the moisture runs off because water moves through the soil slowly. In some years crops fail because of insufficient rainfall. A plowpan forms if these soils are plowed consistently at the same depth.

The main crop is wheat. Other small grains, grain sorghum, and cotton are grown occasionally.

A suitable cropping system is one in which wheat or a similar high-residue crop is grown 1 year out of 4; winter peas or a similar soil-improving crop 1 year out of 4; and cotton or other crops the rest of the time. This system helps to preserve good tilth. An alternative system, suitable for years of low rainfall, is small grain and occasional fallow.

Terracing and farming on the contour help to control erosion and to conserve moisture. Grassed waterways are needed to carry water from terrace outlets during heavy rains. Leaving crop residues on or near the surface helps to control evaporation of moisture and to increase the capacity of the soil to absorb rainfall. By varying the depth of plowing, formation of plowpans can be controlled. Yields improve if good seed is planted and insects are controlled.

Capability unit IIe-2

The one soil in this unit, La Casa clay loam, 1 to 3 percent slopes, is reddish brown to brown, deep, and well drained. It has a blocky but friable subsoil.

This soil can be tilled easily, and it is readily penetrated by roots, air, and moisture. Ordinarily, it is slightly droughty. If cultivated, it is slightly susceptible to water erosion, and if it is plowed consistently at the same depth, a plowpan forms.

Most of this soil has remained as rangeland. The areas that are cultivated are used mainly for wheat, cotton, and grain sorghum. Wheat is the main crop.

A suitable cropping system is one in which wheat or a similar high-residue crop is grown 1 year out of 4; winter peas or a similar soil-improving crop 1 year out of 4; and another crop the rest of the time. This system helps to preserve good tilth and maintain high yields. An alternative system, suitable for years of low rainfall, is small grain and occasional fallow.

Terracing and farming on the contour help to control erosion and to conserve moisture. Leaving crop residues on or near the surface helps to control evaporation of moisture and to increase the capacity of the soil to absorb rainfall. Grassed waterways are needed to carry water from terrace outlets during heavy rains. Yields improve if good seed is planted, insects are controlled, and fertilizer is applied according to the needs of the soil and crop.

Capability unit IIe-3

There is only one soil in this unit, Enterprise very fine sandy loam, 1 to 3 percent slopes. This soil is brown to reddish brown, deep, and well drained and has a friable, medium-textured surface layer and subsoil.

This is a fertile soil on the uplands. It can be worked into a good seedbed and tilled easily, but if it is plowed consistently at the same depth, a plowpan forms. Its slight susceptibility to water erosion is the chief hazard in dryland farming.

Cotton and wheat are the main cash crops, but alfalfa and grain sorghum are grown in some areas.

A suitable cropping system is one in which wheat, grain sorghum, or a similar high-residue crop is grown 1 year out of 4; guar, vetch, or a similar soil-improving crop 1 year out of 4; and cotton or another crop the rest of the time. This system helps to preserve good tilth and maintain high yields. An alternative system is wheat or grain sorghum for 3 or 4 years, and then alfalfa for about an equal period.

Terracing and farming on the contour help to control erosion and to conserve moisture. Grassed waterways that carry water from terrace outlets during heavy rains are desirable. Leaving crop residues on or near the surface helps to control evaporation of moisture and to increase the capacity of the soil to absorb rainfall. Varying the depth of plowing helps to prevent the formation of a plowpan. Use good seed, practice insect control, and fertilize according to the needs of the soil and crop. Windbreaks can be grown on this soil.

Capability unit IIe-4

This unit consists of reddish-brown to dark grayish-brown, deep, well-drained, nearly level soils that have a moderately fine textured subsoil. These soils are—

Altus fine sandy loam.
Miles fine sandy loam, 0 to 1 percent slopes.

These soils can be worked into a good seedbed and ordinarily are penetrated easily by roots, air, and moisture. They are moderately well supplied with organic matter and available plant nutrients and have a moderate water-holding capacity. If cultivated and left unprotected, these soils are slightly susceptible to wind erosion. If they are plowed consistently at the same depth, a plowpan forms.

A suitable cropping system is one in which wheat, grain sorghum, or a similar high-residue crop is grown 1 year out of 3; guar, vetch, or a similar soil-improving crop 1 year out of 3; and cotton or another crop the rest of the time. This system helps to preserve good tilth and maintain high yields. An alternative cropping system is a continuous high-residue crop, such as wheat or another small grain, occasionally followed by alfalfa.

Leaving crop residues on or near the surface helps to control wind erosion and evaporation of moisture and to increase the capacity of the soils to absorb rainfall. During years of low rainfall, when there is not enough crop residue to control blowing, either chiseling or listing keeps the soils cloddy or rough and provides some protection from blowing. Growing grain sorghum in alternate strips with cotton or other crops serves to check wind erosion. Vary the depth of plowing to help prevent the formation of a plowpan. Use good seed, control insects, and fertilize according to the needs of the soil and crop. Windbreaks can be grown on these soils.

Capability unit IIe-5

The one soil in this unit is Miles fine sandy loam, 1 to 3 percent slopes. It is a brown to reddish-brown, deep, and well-drained soil that has a moderately fine textured subsoil.

Almost all of this soil is cultivated. It can be tilled easily and worked into a good seedbed. If it is plowed consistently at the same depth, however, a plowpan forms. The soil is moderately well supplied with plant nutrients and organic matter and is easily penetrated by roots, moisture, and air. Its slight susceptibility to wind and water erosion is the chief hazard in dryland farming.

The main crops are cotton, wheat, grain sorghum, and alfalfa.

A suitable cropping system is one in which wheat, grain sorghum, or a similar high-residue crop is grown 1 year out of 3; guar, vetch, or a similar soil-improving crop 1 year out of 3; and cotton or another crop the rest of the time. This system helps to preserve good tilth and maintain high yields. An alternative cropping system is a continuous high-residue crop, such as wheat or another small grain, occasionally followed by alfalfa.

Leaving crop residues on or near the surface helps to control wind erosion and evaporation of moisture and to increase the capacity of the soil to absorb rainfall. During years of low rainfall, when there is not enough crop residue to control blowing, either chiseling or listing keeps the soil cloddy or rough and provides some protection from blowing. Growing grain sorghum in alternate strips with cotton or other crops checks wind erosion. Terracing and farming on the contour help to control water erosion and to conserve moisture. Vary the depth of plowing to help prevent the formation of a plowpan. Use good seed, control insects, and fertilize according to the needs of the soil and crop. Windbreaks can be grown on this soil.

Capability unit IIe-6

The one soil in this unit is Enterprise fine sandy loam, 0 to 1 percent slopes. This is a brown to reddish-brown, deep, well-drained soil that has a moderately coarse textured subsoil.

This soil is moderately well supplied with plant nutrients and organic matter. Almost all of it is cultivated. In most areas it is easy to till and to work into a good seedbed, but if it is plowed consistently at the same depth, a plowpan forms. Roots, air, and moisture readily penetrate the subsoil. The chief hazard in dryland farming is slight wind erosion.

The main crops are cotton, wheat, and alfalfa.

A suitable cropping system is one in which wheat, grain sorghum, or a similar high-residue crop is grown 2 years out of 4; guar, vetch, or a similar soil-improving crop is grown 1 year out of 4; and cotton or another crop the rest of the time. This system helps to preserve good tilth and maintain high yields. An alternative cropping system is a high-residue crop for 3 or 4 years and then alfalfa for about an equal period.

Leaving crop residues on or near the surface helps to control wind erosion and evaporation of moisture and to increase the capacity of the soil to absorb rainfall. During years of low rainfall, when there is not enough crop residue to control blowing, either chiseling or listing keeps the soil cloddy or rough and provides some protection from blowing. Growing grain sorghum in alternate strips with cotton or other crops serves to check soil blowing. Vary the depth of plowing to help prevent the formation of a plowpan. Use good seed, control insects, and fertilize according to the needs of the soil and crop. Windbreaks can be grown on this soil.

Capability unit IIs-1

The one soil in this unit is Tillman clay loam, 0 to 1 percent slopes. It is brown to reddish brown, deep, and moderately well drained. Its subsoil is compact, fine textured, and very slowly drained.

This soil has a good supply of available plant nutrients. It has poor tilth because of its thin surface layer and dense, blocky, fine-textured subsoil. Roots, moisture, and air move very slowly through this soil; consequently, the soil is somewhat droughty. Crops fail during years of low rainfall. A plowpan forms if the soil is plowed consistently at the same depth. The chief hazards in dryland farming are the slow intake of water and the high loss by evaporation.

Wheat is the main crop. Other small grains are grown also, and grain sorghum is grown occasionally.

A suitable cropping system is one that keeps wheat, another small grain, or a similar high-residue crop on the the soil all of the time. Occasionally, this crop can be rotated with winter peas, sweetclover, or vetch. An alternative cropping system is one in which wheat or some other high-residue crop is grown 1 year out of 4; winter peas or a similar soil-improving crop 1 year out

of 4; and cotton or other crops the rest of the time. This system helps to preserve good tilth and maintain high yields.

Leaving crop residues on or near the surface helps to control evaporation of moisture, to increase moisture penetration, and to maintain the supply of organic matter. Diversion terraces on the long slopes help to conserve moisture and to control erosion. Vary the depth of plowing to help prevent the formation of a plowpan. Use good seed and control insects.

Capability unit IIc-1

This unit consists of nearly level, reddish-brown to dark grayish-brown soils that are deep and well drained and have a firm, blocky subsoil. These soils are—

Abilene clay loam, 0 to 1 percent slopes.
Hollister clay loam, 0 to 1 percent slopes.
Spur and Miller clay loams.
Wichita loam, 0 to 1 percent slopes.

All of these soils except Spur and Miller clay loams are on the uplands. All are fertile and have a high capacity for holding moisture and plant nutrients, but because of insufficient rainfall they are not highly productive. Crops fail in some years because of dry weather. A plowpan forms if these soils are plowed consistently at the same depth.

These soils are used mainly for wheat. Cotton and and grain sorghum are grown occasionally.

A suitable cropping system is one in which wheat or a similar high-residue crop is grown 1 year out of 4; winter peas or a similar soil-improving crop 1 year out of 4; and cotton or grain sorghum the rest of the time. An alternative cropping system consists of wheat and occasional fallow.

Leaving crop residues on or near the surface helps to prevent evaporation of moisture and increases the capacity of the soils to absorb rainfall. Diversion terraces on the long slopes conserve moisture and help to control erosion. Plowing at different depths likely will prevent the formation of a plowpan.

Capability unit IIc-2

This unit consists of deep, well-drained, reddish-brown to dark-brown, nearly level soils that have a friable subsoil. These soils are—

Enterprise very fine sandy loam, 0 to 1 percent slopes.
Tipton silt loam.

These fertile soils are on the uplands. They can be tilled easily and worked into a good seedbed, but if they are plowed consistently at the same depth, a plowpan forms. Insufficient rainfall is the main limitation. Crops fail in some years because of dry weather. Failure to maintain fertility and tilth is another hazard in dryland farming.

Cotton, wheat, and alfalfa are the main crops. Grain sorghum is grown occasionally.

A suitable cropping system is one in which wheat, grain sorghum, or a similar high-residue crop is grown 1 year out of 4; winter peas or vetch 1 year out of 4; and cotton or another crop the rest of the time. This system helps to preserve good tilth. An alternative cropping system consists of growing wheat continuously and fertilizing the residue.

Crop residues left on or near the surface help to control evaporation of moisture and to increase the capacity of the soil to absorb rainfall. Vary the depth of plowing to help prevent the formation of a plowpan. Diversion terraces on the long slopes help to conserve moisture and to control erosion. Use good seed, control insects, and fertilize according to the needs of the soil and crop. Windbreaks can be grown on these soils.

Capability unit IIIe-1

The one soil in this unit is Tillman clay loam, 1 to 3 percent slopes. This is a reddish-brown, deep, and moderately well drained soil. It has a fine-textured, compact subsoil that has very slow internal drainage.

This soil has poor tilth because of its thin surface layer and dense, blocky, fine-textured subsoil. It is difficult to work into a good seedbed. Roots, moisture, and air move very slowly through it. Ordinarily, this soil has a good supply of available plant nutrients, but it does not hold enough moisture. Only moderate yields can be expected. Crops fail during years of inadequate rainfall. A plowpan forms if the soil is plowed consistently at the same depth. The chief hazards in dryland farming are moderate water erosion and rapid evaporation of moisture.

The main crop is wheat.

A suitable cropping system is one that keeps wheat or a similar high-residue crop on the land all of the time. Occasionally this crop can be rotated with a soil-improving crop, such as sweetclover, vetch, or winter peas. An alternative cropping system consists of a high-residue crop, such as wheat, grown 2 years out of 3, and a soil-improving crop, such as winter peas, 1 year out of 3. Rotation of crops helps to preserve good tilth and maintain high yields.

Terracing and farming on the contour help to control erosion and to conserve moisture. Leaving the crop residues on or near the surface helps to control the evaporation of moisture, to increase the capacity of the soil to absorb rainfall, to maintain the supply of organic matter, and to improve tilth. Grassed waterways that carry runoff from terrace outlets during heavy rains are desirable. Vary the depth of plowing to help prevent the formation of a plowpan. Use good seed and control insects.

Capability unit IIIe-2

This unit consists of brown to dark grayish-brown, deep soils that have a firm, blocky subsoil. These soils are—

Abilene clay loam, 1 to 3 percent slopes, eroded.
Hollister clay loam, 1 to 3 percent slopes, eroded.

These soils are undesirable for cultivation. For the most part, cultivation is difficult. In addition, these soils have lost most of their surface layer through water erosion and thus can be worked into only a poor seedbed. Roots, moisture, and air move slowly through these soils because they have only a thin surface layer over a firm subsoil. The soils have a good supply of plant nutrients, but they do not hold enough moisture, and they are highly susceptible to water erosion. Yields are low. Crops fail during years of low rainfall.

The main crops are wheat, barley, and oats.

A suitable cropping system is one that keeps a high-residue crop, such as a small grain, on all of the land.

An alternative system is a high-residue crop grown 2 years out of 3 and a soil-improving crop, such as sweetclover or vetch 1 year out of 3. Either of these systems help to preserve good tilth and maintain high yields.

Terracing and contour farming help to prevent further erosion and to conserve moisture. Leaving crop residues on or near the surface helps to conserve moisture and to increase the capacity of the soil to absorb rainfall. Grassed waterways that carry runoff from terrace outlets are desirable, particularly during heavy rains. Use good seed and control insects.

Capability unit IIIe-3

The one soil in this unit is Enterprise very fine sandy loam, 3 to 5 percent slopes. This soil is brown to reddish brown, deep, and well drained; it has a friable, medium-textured surface layer and subsoil.

This fertile soil is on the uplands. Its friable surface can be tilled easily and worked into a good seedbed. Roots and moisture move readily through the friable subsoil. A plowpan forms if this soil is plowed consistently at the same depth. The chief hazard in dryland farming is moderate water erosion.

The main crops are cotton and wheat, but some alfalfa is grown.

A suitable cropping system is one in which wheat, grain sorghum, or a similar high-residue crop is grown 2 years out of 4; vetch, guar, or a similar soil-improving crop 1 year out of 4; and other crops the rest of the time. This system helps to preserve good tilth and maintain high yields. An alternative system is a continuous high-residue crop, such as wheat.

Terracing and farming on the contour help to control water erosion and to conserve moisture. Leaving crop residues on or near the surface helps to conserve moisture and to increase the capacity of the soil to absorb rainfall.

Grassed waterways are needed to carry water from terrace outlets during heavy rains. Use good seed, control insects, and fertilize according to the needs of the soil and crop. Windbreaks can be grown on this soil.

Capability unit IIIe-4

The one soil in this unit is Miles fine sandy loam, 3 to 5 percent slopes. This is a brown to reddish-brown, deep, and eroded soil. It has a moderately fine textured subsoil.

This soil is moderately fertile and has moderate capacity for holding plant nutrients and moisture. About half of it is cultivated. Because of the slope, runoff is high. Consequently, not enough subsoil moisture is available to plants and yields are low. The chief hazard in dryland farming is moderate water erosion. Several gullies have formed.

The areas that are cultivated are used mainly for wheat and cotton.

A suitable cropping system is one that keeps barley, wheat, oats, or a similar, continuous high-residue crop on all of the land. An alternative cropping system consists of suitable perennial grasses, used for grazing or hay, rotated occasionally with an annual high-residue crop.

Terracing and contour farming help to prevent further erosion and to conserve moisture. Leaving crop residues on or near the surface helps to conserve moisture and to increase the capacity of the soil to absorb rainfall. Grassed waterways are needed to carry water from terrace outlets during heavy rains. Use good seed, control insects, and fertilize according to the needs of the soil and crop.

Capability unit IIIe-5

The one soil in this unit, Enterprise fine sandy loam, 1 to 3 percent slopes, is brown to reddish brown, deep, and well drained. It has a moderately coarse textured subsoil.

In most places this soil can be worked into a good seedbed, but it may be slightly difficult to manage in some sandy spots. It is only moderately well supplied with plant nutrients. If it is plowed consistently at the same depth, a plowpan forms. The chief hazard in dryland farming is slight susceptibility to wind and water erosion.

Cotton, wheat, and alfalfa are the main crops. Ordinarily, alfalfa does not grow well after midsummer.

A suitable cropping system is one in which wheat, grain sorghum, or a similar high-residue crop is grown about two-thirds of the time, and alfalfa, guar, vetch, or a similar soil-improving crop one-third of the time. An alternative system is a high-residue crop, such as wheat or grain sorghum, 2 years out of 4; a soil-improving crop, such as alfalfa or guar, 1 year out of 4; and cotton the rest of the time. Either of these systems helps to preserve good tilth and maintain high yields.

Leaving crop residues on or near the surface helps to conserve moisture, to increase the capacity of the soil to absorb rainfall, and to control wind erosion. During years of low rainfall, when there is not enough crop residue to control blowing, either chiseling or listing keeps the soil cloddy or rough and provides some protection from blowing. Growing grain sorghum in alternate strips with cotton or other crops serves to check wind erosion. Use good seed, control insects, and fertilize according to the needs of the soil and crop. Windbreaks can be grown on this soil.

Capability unit IIIe-6

The one soil in this unit, Miles loamy fine sand, 0 to 3 percent slopes, is brown to reddish brown, deep, and well drained. It has a moderately fine textured subsoil.

This soil absorbs water readily; little runoff occurs, even after heavy rains. The surface layer is low in fertility and in water-holding capacity. Ordinarily, it is also low in its supply of organic matter and available plant nutrients. The chief hazard in dryland farming is high susceptibility to wind erosion.

This is the most extensive alfalfa-producing soil in the county, and if properly fertilized, it is highly productive. Cotton also is a main crop.

A suitable cropping system is one in which grain sorghum, wheat, or a similar high-residue crop is grown 2 years out of 4; guar, vetch, or a similar soil-improving crop is grown 1 year out of 4; and other crops the remaining time. This system helps to preserve good tilth and maintain high yields. An alternative cropping system is a high-residue crop for 2 or 3 years, and then alfalfa for about an equal period.

Leaving the residues on or near the surface helps to control erosion and to conserve moisture. Such emergency tillage as listing may be needed during dry years, when there is not enough crop residue to control blowing. Deep plowing is beneficial if one-fourth to one-third of the plow slice is fine-textured material. Properly timed tillage,

following deep plowing, roughens the surface and results in the formation of stable, erosion-resistant clods. Stripcropping also serves to check soil blowing. Use good seed, control insects, and fertilize according to the needs of the soil and crop. As an additional protection against wind erosion, windbreaks can be grown on this soil.

Capability unit IIIe-7

The one soil in this unit, Cobb fine sandy loam, 1 to 3 percent slopes, is reddish brown, moderately deep, and well drained. It has a moderately fine textured subsoil.

This soil can be tilled easily, and ordinarily it can be worked into a good seedbed, but it is somewhat droughty and consequently is generally poor for row crops. Natural fertility is moderately low. A plowpan forms if the soil is plowed consistently at the same depth. The chief hazard in dryland farming is slight wind and water erosion.

The main crops are wheat and cotton.

A suitable cropping system is one in which wheat, grain sorghum, or a similar high-residue crop is grown 2 years out of 4; guar, vetch, or a similar soil-improving crop is grown 1 year out of 4; and cotton or other crops the remaining time. This system helps to preserve good tilth and maintain high yields. An alternative cropping system is a high-residue crop followed by hay or a pasture crop of suitable perennial grasses.

Terracing and contour farming help to control erosion and to conserve moisture. Leaving the crop residues on or near the surface helps to conserve moisture, to increase the capacity of the soil to absorb rainfall, and to control wind erosion. Stripcropping serves as an excellent barrier to check soil blowing. Emergency tillage, such as listing or chiseling, may be needed during dry years, when there is not enough crop residue to control blowing. Grassed waterways are needed to carry water from terrace outlets during heavy rains. Vary the depth of plowing to help prevent the formation of a plowpan. Use good seed, control insects, and fertilize according to the needs of the soil and crop.

Capability unit IIIs-1

The one soil in this unit, Miller clay, is reddish brown, deep, moderately well drained, and nearly level. Its surface layer and subsoil are compact and fine textured, and it is very slowly drained.

This soil is droughty and is not well suited to cultivation, although it is high in plant nutrients. Moisture, air, and roots move through it very slowly. The fine-textured surface layer is difficult to work into a good seedbed. Yields are low, and crops fail during periods of low rainfall. Most of the acreage is used as rangeland. The areas that are cultivated are used for wheat.

A suitable cropping system is one in which wheat, oats, barley, or a similar high-residue crop is grown 2 years out of 3, and sweetclover, vetch, or a similar soil-improving crop 1 year out of 3. This system helps to preserve good tilth and maintain high yields. An alternative system is a high-residue crop, such as wheat, grown continuously.

Leaving crop residues on or near the surface helps to conserve moisture and to increase the capacity of the soil to absorb rainfall. Use good seed, and control insects.

Capability unit IIIs-2

This unit consists of the Abilene-slickspot complex. These soils are brown to dark grayish brown, deep, moderately well drained, and nearly level. Salt spots occur in the surface layer.

Because of the salt spots and a thick surface crust, these soils have poor tilth. They puddle easily when wet and harden when dry. Penetration of moisture is slow when the surface is puddled. The salt accumulations make it difficult for plants to emerge. The chief hazards in dryland farming are poor tilth and rapid evaporation of moisture.

The main crops are barley, wheat, and sudangrass.

A suitable cropping system is one that keeps barley, wheat, oats, or a similar high-residue crop on the land all of the time. An alternative cropping system is a suitable perennial grass, such as switchgrass, and occasionally a high-residue annual crop.

Leaving the crop residues on or near the surface helps to conserve moisture and to increase the capacity of the soil to absorb rainfall. Use good seed, control insects, and fertilize according to the needs of the crop and soils.

Capability unit IVe-1

The one soil in this unit, Tillman clay loam, 1 to 3 percent slopes, eroded, is reddish brown and deep. It has a fine-textured, compact subsoil that is very slowly drained.

This soil is not suitable for cultivation. In most areas almost all of the original surface layer has been removed by water erosion, and in many places crossable gullies have formed. Because of the slope and past erosion, runoff ordinarily is rapid. The fine-textured subsoil, which is exposed in most areas, is droughty and absorbs moisture slowly; as a result, yields generally are low.

The main crops are wheat, grain sorghum, oats, and barley.

A suitable cropping system is one that keeps wheat, barley, or a similar high-residue crop on all of the land. An alternative cropping system is suitable perennial grasses and an occasional annual crop.

Terracing and contour farming help to control further erosion and to conserve moisture. Grassed waterways are needed to carry water from terrace outlets during heavy rains. Leaving the crop residues on or near the surface helps to conserve moisture and to increase the capacity of the soil to absorb rainfall. Use good seed, and control insects.

Capability unit IVe-2

The one soil in this unit, Springer loamy fine sand, undulating, is light brown to reddish brown, deep, well drained, and nearly level to gently sloping. It has a moderately coarse textured subsoil.

This soil absorbs water readily; little runoff occurs, even after heavy rains. The surface layer and subsoil generally are low in available plant nutrients. The chief hazard in dryland farming is high susceptibility to wind erosion.

This sandy soil is used mainly for cotton, alfalfa, and grain sorghum. Alfalfa generally grows well throughout the season.

A suitable cropping system is one that keeps grain sorghum, rye, or a similar high-residue crop on the land about two-thirds of the time. The acreage not used for high-residue crops at any given time can be planted to cotton, and a drilled crop, such as rye, can be seeded between the rows of cotton stalks in fall. An alternative

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cropping system is a high-residue crop for 3 or 4 years, and then alfalfa for an equal period.

Leaving the residues on or near the surface helps to control erosion, to conserve moisture, and to increase the capacity of the soil to absorb rainfall. Emergency tillage, such as listing, may be needed during dry years, when there is not enough crop residue to control blowing. Stripcropping serves to check wind erosion. As an added protection, windbreaks can be grown on this soil. Use good seed, control insects, and fertilize according to the needs of the soil and crop.

Capability unit IVe-3

This unit consists of reddish-brown to dark grayish-brown, shallow, well-drained soils that are gently sloping to moderately sloping. These soils have a moderately fine textured or moderately coarse textured surface layer and a moderately fine textured subsoil. They are—

Acme soils in the Cottonwood-Acme complex.
Acme soils in the Cottonwood-Vernon-Acme complex.
Cobb fine sandy loam, shallow variant.
Cobb soils in the Cobb-Quinlan complex.
Vernon soils in the Vernon-badland complex.
Vernon-Weymouth clay loams, 1 to 3 percent slopes.

These soils are droughty and therefore are not suitable for row crops. Ordinarily, they are difficult to cultivate because of the outcrops of gypsum and clayey sandstone. They are low in natural fertility.

The Acme soils and the soils of both the Cobb-Quinlan complex and Vernon-badland complex are used as rangeland. Only about one-third of the acreage of the other soils in this unit is cultivated. The chief hazard in dryland farming is moderate water erosion.

The main crops are wheat, cotton, barley, and oats.

A suitable cropping system is one that keeps wheat, barley, or a similar high-residue crop on all of the land. An alternative system is suitable perennial grasses and occasionally an annual crop.

Terracing and contour farming help to control erosion and to conserve moisture. Grassed waterways are needed to carry water from terrace outlets during heavy rains. Leaving the residues on or near the surface helps to conserve moisture and to increase the capacity of the soil to absorb rainfall. Use good seed, and control insects.

Capability unit IVw-1

The one soil in this unit, Randall clay, is dark gray, nearly level, deep, and poorly drained. It has a fine-texured subsoil.

This soil is seasonally wet. Careful management is required for only average yields. It is easy to cultivate this soil, but ordinarily it cannot be worked into a good seedbed. Moisture, air, and roots penetrate it slowly.

The main crops are wheat and barley.

A suitable cropping system is one in which wheat, barley, or a similar high-residue crop is grown 2 years out of 4; a soil-improving crop, such as sweetclover, winter peas, or vetch is grown 1 year out of 4; and another crop the rest of the time. An alternative cropping system is a close-growing, high-residue crop on all the land, and occasional fallow during dry years.

Leaving the crop residues on or near the surface helps to conserve moisture and to increase the capacity of the soil to absorb rainfall. Use good seed, and control insects.

Capability unit Vw-1

The one land type in this unit, Loamy alluvial land, is brown to reddish brown, deep, saline, and poorly drained. It is on the bottom lands and is frequently flooded by runoff from surrounding areas. Because of the hazard of flooding and scouring and the deposition of fresh materials, it is not suitable for cultivation. Some areas are suitable for farm ponds and wildlife habitats.

This land type should be managed to (1) leave a minimum of 50 percent of each season's growth of grasses; (2) provide planned periods of deferred grazing, which will allow maximum growth of grasses; and (3) control brush and mesquite trees by chemical spraying, root plowing, or tree dozing. Most areas are too small to be cross fenced.

This land type is in the Loamy Bottomland range site, which is described in the section "Range Management."

Capability unit Vw-2

The one land type in this unit, Sandy alluvial land, is brown to reddish brown, deep, and poorly drained. It is frequently flooded by runoff from surrounding areas. It occurs mostly on the flood plains of the Pease and Wichita Rivers. It is not suitable for cultivation because of the hazard of flooding and scouring and the deposition of fresh materials. Some areas are suitable for the development of wildlife habitats.

This land type should be managed to (1) leave a minimum of 50 percent of each season's growth of grasses; (2) provide planned periods of deferred grazing, which will allow maximum growth of grasses; and (3) control saltcedar brush by tree dozing. Most areas are too narrow to be cross fenced.

This land type is in the Sandy Bottomland range site, which is described in the section "Range Management."

Capability unit VIe-1

The one soil in this unit, Springer loamy fine sand, hummocky, is deep, well drained, and moderately sloping to sloping. It has a moderately coarse textured subsoil.

This soil is inextensive in this county and occurs only as small tracts. The moisture-holding capacity and the supply of plant nutrients are low. Nevertheless, most of the acreage is cultivated. It is not suitable for cultivation because it is steep and is highly susceptible to wind erosion. Careful management is required, even where there is a fairly good cover of native vegetation.

Practices that help to control wind erosion and to conserve moisture include (1) reseeding the cultivated areas to tall native grasses, such as switchgrass, Indiangrass, little bluestem, or caucasian bluestem; (2) leaving about 50 percent of each season's growth; and (3) providing planned periods of deferred grazing, which will allow maximum growth of grasses.

This soil is in the Sandy Land range site, which is described in the section "Range Management."

Capability unit VIe-2

This unit consists of reddish-brown, shallow and very shallow, excessively drained soils that are moderately sloping. The surface layer and subsoil are moderately

fine textured and moderately coarse textured. These soils are—

- Quinlan soils in the Cobb-Quinlan complex.
- Vernon soils in the Cottonwood-Vernon-Acme complex.
- Vernon-Weymouth clay loams, 3 to 5 percent slopes.
- Vernon soils in the Cottonwood-Ector-Vernon complex.

Because these soils are shallow and steep, they are not suitable for cultivation. They are highly susceptible to water erosion if they are not protected. Most of the acreage has remained as rangeland. The Vernon-Weymouth soils, particularly those areas along shallow drainageways, are suitable for farm ponds.

Practices that help to control erosion and to conserve moisture include (1) providing planned periods of deferred grazing, which will allow maximum growth of grasses; (2) leaving about 50 percent of each season's growth; and (3) reseeding cultivated areas to suitable native short and mid grasses, such as buffalograss, blue grama, and side-oats grama. Most areas are too small to be cross fenced.

Capability unit VIs–1

The one land type in this unit, Gravelly rough land, is moderately deep and moderately sloping to strongly sloping. Because it is steep and gravelly, it is not suitable for cultivation. If properly managed, it supports a fair cover of mid grasses. Most areas are small and should be managed like areas in the surrounding range sites. Proper range management consists of (1) leaving a minimum of 50 percent of each season's growth; and (2) providing planned periods of deferred grazing, which will allow maximum growth of grasses.

This land is in the Gravelly range site, which is described in the section "Range Management."

Capability unit VIIe–1

The one soil in this unit, Tivoli fine sand, is light colored, deep, and moderately sloping to sloping. It is inextensive and occurs as small tracts.

This coarse-textured soil is highly erodible; it is likely to blow even when it is fairly well covered with vegetation. Because of this erosion hazard, the steep slopes, and low natural fertility, this soil is not suitable for cultivation.

Practices that help to control wind erosion and to conserve moisture include (1) leaving a minimum of 50 percent of each season's growth; (2) providing planned periods of deferred grazing, which will allow maximum growth of grasses; and (3) controlling sagebrush by shredding, and shin oak by chemical spraying.

This soil is in the Deep Sand range site, which is described in the section "Range Management."

Capability unit VIIs–1

This unit consists of dark-colored, shallow and very shallow, moderately sloping to steep soils that are stony and contain outcrops of gypsum. These soils are—

- Cottonwood soils in the Cottonwood-Ector-Vernon complex.
- Cottonwood soils in the Cottonwood-Acme complex.
- Cottonwood soils in the Cottonwood-Vernon-Acme complex.
- Ector soils.
- Ector soils in the La Casa-Ector complex.
- Ector soils in the Cottonwood-Ector-Vernon complex.

These soils are not suitable for cultivation, because they are shallow, steep, and highly susceptible to erosion. Although they support some vegetation, careful management is needed to control water erosion. They should be managed to (1) leave a minimum of 50 percent of each season's growth; (2) provide planned periods of deferred grazing, which will allow maximum growth of grasses; (3) control redberry juniper by tree dozing, and mesquite trees by tree dozing or chemical spraying; (4) provide rotation grazing by fencing; and (5) prevent overgrazing by rotating the salting areas.

The Ector soils are in the Very Shallow range site, and the Cottonwood soils are in the Gyp Land range site. Both sites are described in the section "Range Management."

Capability unit VIIIs–1

The one land type in this unit, Badland, is gently sloping to steep and consists of clayey soil material. It is mapped separately and also in a complex with the Vernon soils.

This land type is severely eroded and supports no vegetation. It is suitable only for wildlife. Some of the less strongly sloping areas are suitable for ponds.

Badland is not suitable for use as range and therefore is not assigned to a range site.

General Management of Cultivated Soils

The chief hazards to farming the soils in Foard County result from the low average rainfall, occasional droughts, some rains of high intensity, and strong winds. The purposes of management, then, are to conserve moisture, to protect the soils against both wind erosion and water erosion, to improve tilth, and to maintain productivity.

Erosion control.—Erosion by both wind and water is a serious problem in many places in Foard County. The loss of any of the surface soil reduces the supply of organic matter and plant nutrients. It also makes the soil less absorbent. Consequently, more water runs off, the rate of erosion increases, and the supply of moisture decreases.

Wind erosion is most easily recognized on some of the coarse-textured soils (fig. 29). The silt and clay and some sand particles have been blown away, and the infertile sand grains are left. On the moderately fine textured

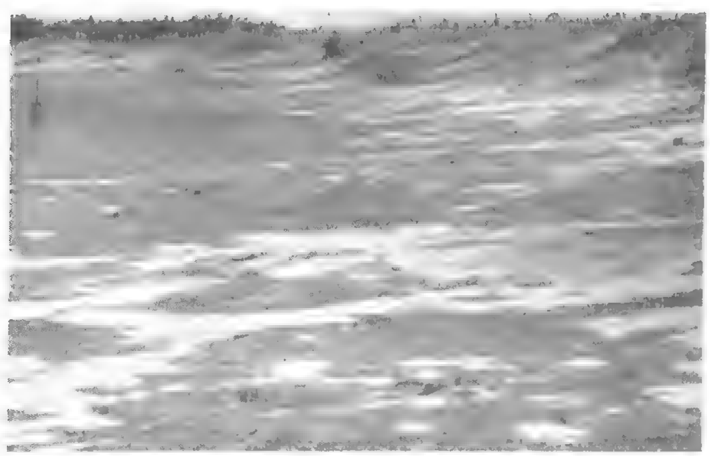

Figure 29.—Effects of wind erosion on Springer loamy fine sand.

Figure 30.—**Stubble mulching on Abilene soils.**

Figure 31.—**Terracing and contouring on Miles fine sandy loam.**

soils, it is more difficult to distinguish between the damage done by wind erosion and that done by water erosion.

To help control wind erosion, keep vegetation on the soil at all times. This may be either a growing crop or crop residues, such as sorghum stubble, wheat stubble (fig. 30), or cotton burs.

Stripcropping, or growing protective crops in alternate strips or bands with other crops, provides barriers to wind erosion. If wind erosion starts on an unprotected field, emergency tillage to roughen the surface may be necessary to hold the soil until a crop can be established.

Water may cause either sheet or gully erosion. The degree of erosion depends on the length and steepness of the slopes, the texture and structure of the soil, the rate at which water is absorbed , and the vegetation.

To help control water erosion, (1) terrace, if the soils are not too sandy and if the slope does not exceed 5 percent; (2) divert water that runs off higher areas; (3) till and plant on the contour (fig. 31); (4) utilize crop residues; and (5) use more close-spaced, high-residue crops in the cropping system.

Cropping systems.—A good cropping system provides enough high-residue crops and other protective crops to control erosion. It also includes soil-improving crops that help to keep the soil in good tilth and at a reasonable level of fertility. The principal soil-improving crops grown in the county are legumes and perennial grasses. Other high-residue crops, such as small grain, grain sorghum, forage sorghum, and sudangrass, are soil-improving crops if (1) the crop is fertilized and the residues are returned to the soil; (2) the residues are fertilized and returned to the soil; or (3) the crop is incorporated into the soil as a green-manure crop.

Use of fertilizers.—According to the farmers in this county, many of the soils need applications of commercial fertilizers. This is also verified by the many laboratory tests of soils. The coarse textured and moderately coarse textured soils respond readily to fertilizers because they absorb moisture from small showers. The silt loams and very fine sandy loams respond during seasons of high rainfall. The silty clay loams and clay loams respond less readily.

Have the soils tested to determine the fertility status. Consult your county agent or a technician of the Soil Conservation Service for information on soil sampling and testing and on fertilizer applications.

Irrigation

Irrigation is a fairly new practice in Foard County. The few irrigation wells are in the northeastern part of the county. These wells are producing from beds of alluvial sandy clays, sands, and gravels of the Seymour formation of the Pleistocene series (*13*).[1] This formation is as much as 85 feet thick and overlies an uneven surface of Permian rocks. The wells produce between 100 and 650 gallons per minute.

Irrigation is a supplemental practice, used chiefly during periods of drought. Sprinkling is the method ordinarily used. Because irrigation is new and is used to only a minor extent, yield data and management of irrigated soils are not discussed in this report.

Crop-Yield Predictions

Yields of crops depend largely on the fertility level of the soil and the adequacy of the supply of moisture. Consistent high yields indicate that the soil has been properly managed. The fertility level probably has been maintained by the use of soil-improving crops, cover crops, or high-residue crops and by the use of fertilizers; most of the rainfall has been retained where it fell and is thus stored for plant use; good seed that is free of weedseeds and of disease has been planted; and insects have been controlled according to prescribed methods.

Consistent low yields generally indicate that the soil has not been properly managed. Much of the rainfall has been allowed to run off or evaporate and is not available for crops; probably neither fertilizers nor soil-improving crops have been used; poor seed has been planted; and insects have not been controlled.

[1] Italic numbers in parentheses refer to Literature Cited, p. 70.

Table 2 gives yield predictions for the principal cultivated crops under two levels of dryland management.

A. Low-level management.
   1. Soil-improving crops are not used in the rotation.
   2. Crop residues are destroyed or turned under too rapidly.
   3. Water conservation is only partial.
   4. Fertilizers are not used.
   5. Tillage alone is depended on to control wind erosion.
   6. Poor seed is used.
   7. Insects are not controlled.

B. High-level management.
   1. Soil-improving crops, cover crops, or high-residue crops are used in the rotation.
   2. Crop residues are kept on the surface to help control wind erosion.
   3. Water is conserved by all possible means.
   4. Fertilizers are applied according to soil and crop needs.
   5. Good seed is used.
   6. Insects are controlled.

The predictions in table 2 were obtained from interviews with farmers and from records of the local experiment station. Yields of alfalfa hay on a particular soil vary

TABLE 2.—*Crop-yield predictions for the principal crops under two levels of management*

[Yields in columns A are those obtained under low-level management; yields in columns B are those obtained under high-level management (see text). Dashes indicate that the crop is not grown at the management level indicated or the soil is not suited to the crop]

Soil	Cotton		Wheat		Grain sorghum		Alfalfa		Barley		Oats		Rye	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Pounds of lint	*Pounds of lint*	*Bushels*	*Bushels*	*Pounds*	*Pounds*	*Tons*	*Tons*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*
Abilene clay loam, 0 to 1 percent slopes	150	175	14	18	800	900	----	----	18	25	28	35	----	----
Abilene clay loam, 1 to 3 percent slopes	125	160	13	16	700	800	----	----	16	22	25	32	----	----
Abilene clay loam, 1 to 3 percent slopes, eroded	100	110	8	10	600	800	----	----	14	18	22	28	----	----
Abilene-slickspot complex	----	----	7	10	----	----	----	----	12	18	24	24	----	----
Altus fine sandy loam	315	340	20	20	1,000	1,200	2.0	2.5	20	24	----	----	----	----
Badland	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Cobb fine sandy loam, 1 to 3 percent slopes	125	160	10	12	700	800	----	----	14	18	22	28	10	12
Cobb fine sandy loam, shallow variant	100	120	8	10	650	700	----	----	12	14	18	24	8	10
Cobb-Quinlan complex	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Cottonwood-Acme complex	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Cottonwood-Ector-Vernon complex	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Cottonwood-Vernon-Acme complex	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Ector soils	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Enterprise fine sandy loam, 0 to 1 percent slopes	175	200	16	20	850	950	1.0	1.5	----	----	----	----	----	----
Enterprise fine sandy loam, 1 to 3 percent slopes	165	180	14	18	750	850	1.0	1.5	15	18	22	28	10	12
Enterprise very fine sandy loam, 0 to 1 percent slopes	325	375	20	30	1,200	1,600	1.0	1.5	----	----	----	----	----	----
Enterprise very fine sandy loam, 1 to 3 percent slopes	175	250	18	25	1,000	1,250	1.0	1.5	18	25	28	36	----	----
Enterprise very fine sandy loam, 3 to 5 percent slopes	165	175	12	15	900	975	.8	1.2	16	20	25	32	----	----
Gravelly rough land	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Hollister clay loam, 0 to 1 percent slopes	130	155	13	15	800	900	----	----	18	25	----	----	----	----
Hollister clay loam, 1 to 3 percent slopes	120	145	11	13	700	800	----	----	16	22	25	32	----	----
Hollister clay loam, 1 to 3 percent slopes, eroded	90	100	7	9	600	800	----	----	14	18	22	28	----	----
La Casa clay loam, 1 to 3 percent slopes	115	130	10	12	700	800	----	----	17	24	26	34	----	----
La Casa-Ector complex	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Loamy alluvial land	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Miles loamy fine sand, 0 to 3 percent slopes	125	250	10	14	750	1,000	3.0	4.5	----	----	----	----	8	10
Miles fine sandy loam, 0 to 1 percent slopes	200	250	17	22	1,000	1,200	2.0	2.5	20	28	----	----	12	15

TABLE 2.—*Crop-yield predictions for the principal crops under two levels of management*—Continued

Soil	Cotton		Wheat		Grain sorghum		Alfalfa		Barley		Oats		Rye	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B
	Pounds of lint	*Pounds of lint*	*Bushels*	*Bushels*	*Pounds*	*Pounds*	*Tons*	*Tons*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*	*Bushels*
Miles fine sandy loam, 1 to 3 percent slopes	175	225	16	20	900	1, 050	2. 0	2. 5	18	24	26	34	10	13
Miles fine sandy loam, 3 to 5 percent slopes	120	140	7	9	700	900	------	------	16	20	25	32	8	10
Miller clay	------	------	8	10	------	------	------	------	14	18	22	28	------	------
Randall clay	------	------	13	15	------	------	------	------	16	20	25	32	------	------
Sandy alluvial land	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Springer loamy fine sand, undulating	125	200	------	------	700	800	2. 5	4. 0	------	------	------	------	10	12
Springer loamy fine sand, hummocky	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Spur clay loam	125	225	16	20	1, 200	1, 400	2. 0	2. 5	------	------	------	------	------	------
Spur silt loam	275	300	20	24	1, 200	1, 400	2. 0	2. 5	------	------	------	------	------	------
Spur and Miller clay loams	------	------	14	18	------	------	------	------	15	18	------	------	------	------
Tillman clay loam, 0 to 1 percent slopes	125	140	10	12	700	800	------	------	17	24	25	32	------	------
Tillman clay loam, 1 to 3 percent slopes	115	130	9	11	650	700	------	------	15	20	24	30	------	------
Tillman clay loam, 1 to 3 percent slopes, eroded	------	------	6	8	600	700	------	------	12	14	18	24	------	------
Tipton silt loam	325	375	22	30	1, 300	1, 600	2. 0	2. 5	------	------	------	------	------	------
Tivoli fine sand	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Vernon-badland complex	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Vernon-Weymouth clay loams, 1 to 3 percent slopes	------	------	6	8	------	------	------	------	12	14	18	24	------	------
Vernon-Weymouth clay loams, 3 to 5 percent slopes	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Wichita clay loam, 1 to 3 percent slopes	120	140	11	13	750	900	------	------	16	22	25	32	------	------
Wichita loam, 0 to 1 percent slopes	200	250	17	20	850	950	------	------	------	------	------	------	------	------
Wichita loam, 1 to 3 percent slopes	125	150	17	20	800	900	------	------	16	22	25	32	------	------
Yahola very fine sandy loam	275	300	20	24	1, 200	1, 400	2. 0	2. 5	------	------	------	------	------	------

considerably from farm to farm. Where ground water is near the surface, yields increase about one-half ton per acre.

Range Management [2]

Ranching and livestock farming are the most important enterprises in Foard County. Approximately 45 percent of the agricultural land is used mainly for the production of livestock. There are 51 ranching units ranging from 750 to some 100,000 acres in size. Most of these units are cow-calf enterprises, but many ranchers buy steer calves in fall and let them graze on small grain in winter and early in spring. Practically all of the ranches include some cropland on which small grain, sudangrass, Johnsongrass, and various sorghum crops are raised for supplemental grazing. Perennial grasses planted in rotation with cultivated crops are sometimes used for grazing.

Most of the native grassland is in the western and southern parts of the county, within the zone of mixed-prairie vegetation. It produces a mixture of highly nutritious grasses.

[2] Prepared by JOE B. NORRIS, range conservationist, Soil Conservation Service, Lubbock, Tex.

Range sites and condition classes

Range sites are kinds of rangeland that differ from each other in their ability to produce range vegetation. Within a given climate, they differ only in the kind or amount of vegetation they can produce. These differences result from differences in such soil characteristics as depth, texture, structure, and position, and to a lesser extent, exposure and elevation.

The kind and the amount of vegetation a given site can produce depend upon the fertility and aeration of the soil and its ability to absorb and retain water. A deep, fertile, bottom-land range site that receives floodwater in addition to the normal rainfall will produce taller grasses and higher yields than an upland site or a shallow site that receives a lesser amount of water.

Grass, like all other plants, manufactures its food in the green leaves and tender stems. Its growth is directly affected by the degree of grazing use.

Overgrazing reduces or destroys the leaf and stem surface and thus reduces the amount of food available to the plant for maintenance and growth (fig. 32). Continuous overgrazing eliminates many plants.

The most palatable and nutritious plants are the most likely to be overgrazed and are consequently the most

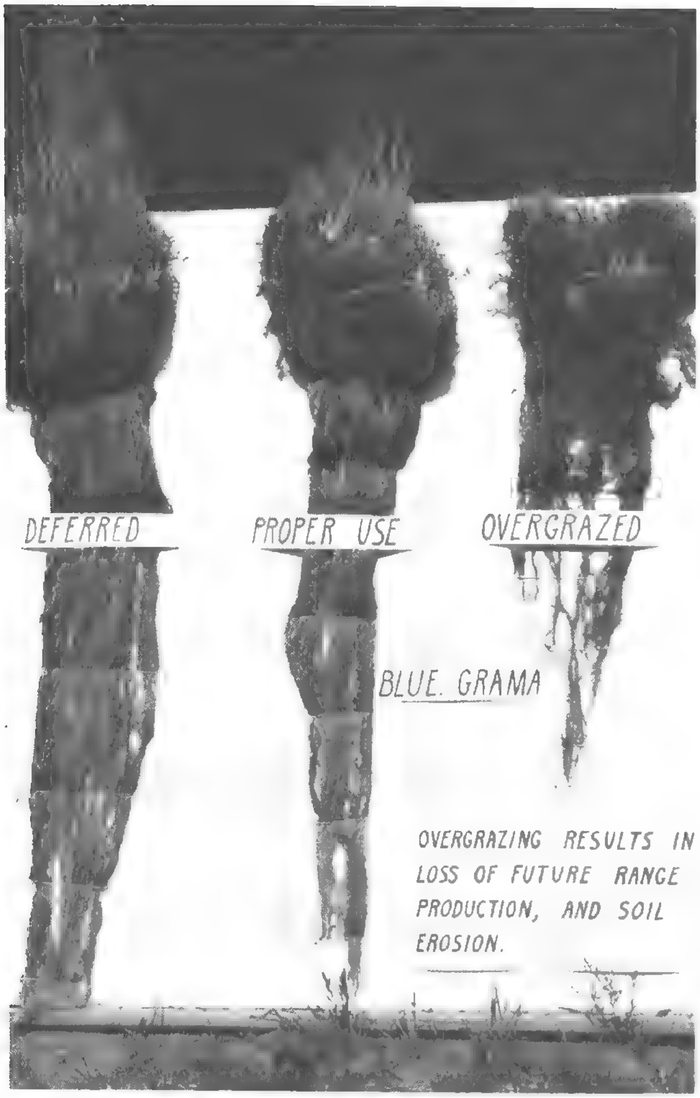

Figure 32.—**Root development of blue grama that has been clipped to represent the results of various degrees of grazing.**

likely to be damaged or destroyed. Such plants decrease under grazing and are called *decreasers*.

As the decreasers are reduced by selective and close grazing, other plants increase in relative amount. These plants that increase under grazing are called *increasers*.

If overgrazing continues, both decreasers and increasers are eliminated, and plants from other sites or areas much farther removed then invade the site. These plants are known as *invaders*.

The composition of vegetation on a range site is indicated by *range condition classes*. If more than 75 percent of the vegetation consists of the original, or climax, plants, the range condition is *excellent;* if the percentage is between 50 and 75, the condition is *good;* if the percentage is between 25 and 50, the condition is *fair;* and if the percentage is less than 25, the condition is *poor*.

Descriptions of range sites

Since range sites have distinguishing characteristics and are easily recognized, they are the logical basis for a discussion of rangeland treatment and management. Each site responds to fluctuations in climate from year to year and to grazing use. This response to grazing depends upon the grazing habits of the various types of livestock and on the palatability of the forage growing on the site.

Although there are generally several range sites in a pasture, one site ordinarily receives grazing preference and is recognized as the key site for the pasture. If grazing of the key site is managed correctly, the rest of the pasture will improve.

In places different soils are intermingled so intricately that they cannot feasibly be mapped separately and thus are mapped as a complex. A complex is likely to be a mixture of range sites. It is uncommon for every soil in a complex to be in the same range site.

The twelve range sites in Foard County are described on the following pages. They include all of the areas mapped except the Badland areas, which have no agricultural use.

SANDY BOTTOMLAND SITE

This site occupies nearly level areas along the rivers and streams in the county. It consists entirely of Sandy alluvial land.

This site produces a wide variety of vegetation (fig. 33). Decreasers include sand bluestem, Indiangrass, switchgrass, little bluestem, side-oats grama, and Canada wildrye. Increasers are meadow dropseed, Texas bluegrass, western wheatgrass, silver bluestem, vine-mesquite, and hairy grama. Alkali sacaton is an increaser if the soils are saline. Invaders are sand dropseed, buffalograss, three-awn, hooded windmillgrass, western ragweed, sand sagebrush, mesquite, inland saltgrass, and saltcedar.

Deposition from overflow occurs frequently. Parts of the site are almost completely covered with sediments.

Figure 33.—**Little bluestem, sand bluestem, switchgrass, and Indiangrass on Sandy Bottomland range site in excellent condition.**

Preliminary data indicate that the potential herbage yield of this site varies between approximately 5,600 pounds per acre in favorable years and 2,500 pounds per acre in unfavorable years.

DEEP HARDLAND SITE

This site occurs as nearly level to gently sloping upland plains. The slope is ordinarily not more than 3 percent. The soils in this site are—

Abilene clay loam, 0 to 1 percent slopes.
Abilene clay loam, 1 to 3 percent slopes.
Abilene clay loam, 1 to 3 percent slopes, eroded.
Abilene-slickspot complex.
Cottonwood-Acme complex (Acme soil).
Cottonwood-Vernon-Acme complex (Acme soil).
Hollister clay loam, 0 to 1 percent slopes.
Hollister clay loam, 1 to 3 percent slopes.
Hollister clay loam, 1 to 3 percent slopes, eroded.
La Casa clay loam, 1 to 3 percent slopes.
La Casa-Ector complex (La Casa soil).
Randall clay.
Spur and Miller clay loams (Miller soil).
Tillman clay loam, 0 to 1 percent slopes.
Tillman clay loam, 1 to 3 percent slopes.
Tillman clay loam, 1 to 3 percent slopes, eroded.
Vernon-Weymouth clay loams, 1 to 3 percent slopes (Weymouth soil).
Vernon-Weymouth clay loams, 3 to 5 percent slopes (Weymouth soil).
Wichita clay loam, 1 to 3 percent slopes.
Wichita loam, 0 to 1 percent slopes.
Wichita loam, 1 to 3 percent slopes.

These soils are high in fertility. They have a high capacity for holding water, but they absorb water slowly; consequently, they are somewhat droughty and support only short and mid grasses. The main decreasers are blue grama, side-oats grama, vine-mesquite, Arizona cottontop, and western wheatgrass. Increasers include buffalograss, tobosa, and Texas wintergrass. Invaders are hairy tridens, Texas grama, mesquite, pricklypear, condalia, and annual weeds.

Pitting or chiseling is often used to "open up" the soil temporarily so as to allow water to enter rapidly. The supplemental water increases the vigor of the plants and enhances their chances of survival. Maintaining a healthy stand of grasses at all times is the best way to improve the site.

Preliminary data indicate that the potential herbage yield of this site varies between 2,700 pounds per acre in favorable years and 1,575 pounds per acre in unfavorable years.

LOAMY BOTTOMLAND SITE

This site occurs as level to gently sloping areas along rivers and intermittent streams. The soils in this site are—

Loamy alluvial land.
Spur clay loam.
Spur silt loam.
Spur and Miller clay loams (Spur soil).
Yahola very fine sandy loam.

This site is the most productive in the county. Extra moisture received from overflowing streams, and as runoff from adjacent uplands, makes growing conditions favorable for tall grasses. The dominant tall grasses in the potential plant community are Indiangrass, switchgrass, little bluestem, Canada wildrye, sand bluestem, and side-oats grama. Increasers are vine-mesquite, meadow dropseed, Texas wintergrass, white tridens, and western wheatgrass. Invaders are buffalograss, three-awn, western ragweed, mesquite, pricklypear, and annual weeds.

Tall trees, such as pecan, elm, and cottonwood, occur in limited number in the climax vegetation.

Preliminary data indicate that the potential herbage yield varies between 5,800 pounds per acre in favorable years and 2,500 pounds per acre in unfavorable years.

GYP LAND SITE

This site, the topography of which ranges from nearly level and rolling to steep, occurs as small areas scattered through other sites. It consists entirely of the Cottonwood soils. In this county, Cottonwood soils are mapped as parts of three different complexes: (1) the Cottonwood-Acme complex, (2) the Cottonwood-Ector-Vernon complex, and (3) the Cottonwood-Vernon-Acme complex.

The amount of gypsum in the soil directly affects the kind and amount of vegetation. Ordinarily this site supports mid and tall grasses, including such decreasers as little bluestem, side-oats grama, and blue grama, and lesser amounts of sand bluestem, Indiangrass, and switchgrass. Where the gypsum content is high, the dominant decreasers are side-oats grama and hairy grama, and there are lesser amounts of little bluestem. Increasers are buffalograss, fall witchgrass, Reverchon panicum, black grama, and silver bluestem. Invaders include hairy tridens, Texas grama, mesquite, redberry juniper, catclaw, and annual weeds. Where the gypsum content is extremely high, the herbage yield is materially reduced and varies between 1,000 pounds in favorable years and 300 pounds in less favorable years.

Preliminary data indicate that the potential herbage yield varies between 2,225 pounds per acre in favorable years and 1,050 pounds per acre in unfavorable years.

SANDY LOAM SITE

This highly productive site consists of upland plains and to some extent of ridges or rolling terrain. The slope ordinarily does not exceed 8 percent. The soils in this site are—

Altus fine sandy loam.
Cobb fine sandy loam, 1 to 3 percent slopes.
Cobb fine sandy loam, shallow variant.
Cobb-Quinlan complex.
Enterprise fine sandy loam, 0 to 1 percent slopes.
Enterprise fine sandy loam, 1 to 3 percent slopes.
Miles fine sandy loam, 0 to 1 percent slopes.
Miles fine sandy loam, 1 to 3 percent slopes.
Miles fine sandy loam, 3 to 5 percent slopes.

This site produces a wide variety of vegetation. The soils absorb light rainfall effectively and hold moisture for long periods. Decreasers in the potential plant community are side-oats grama, little bluestem, Arizona cottontop, plains bristlegrass, and vine-mesquite. Increasers are buffalograss, blue grama, hairy grama, and silver bluestem. Invaders are fall witchgrass, mesquite, pricklypear, yucca, and many annuals.

Preliminary data indicate that the potential herbage yield varies between 3,600 pounds per acre in favorable years and 2,300 pounds per acre in unfavorable years.

DEEP SAND SITE

The areas are hummocky or duned, and there are many areas of stabilized dunes. The site consists entirely of Tivoli fine sand.

The decreasers in the potential plant community include Indiangrass, switchgrass, little bluestem, and sand bluestem. The increasers are side-oats grama, hairy grama, silver bluestem, and giant dropseed. Common invaders are gummy lovegrass, red lovegrass, tumble lovegrass, and numerous annuals. At one time shin oak was only a small component of the plant community, but because the better forage plants have been overgrazed, it has increased throughout the site and in many places is now the dominant vegetation.

Preliminary data indicate that the potential herbage yield of this site varies between 3,000 pounds per acre in favorable years and 2,100 pounds per acre in unfavorable years.

SANDY LAND SITE

The topography of this site is predominantly nearly level but may be gently undulating or hummocky. The soils are—

Miles loamy fine sand, 0 to 3 percent slopes.
Springer loamy fine sand, undulating.
Springer loamy fine sand, hummocky.

This site supports a variety of vegetation. Decreasers include Indiangrass, sand bluestem (fig. 34), switchgrass,

Figure 34.—**Sandy Land range site. Predominant grass is sand bluestem.**

sand lovegrass, and little bluestem. Increasers include side-oats grama, hairy grama, silver bluestem, giant dropseed, plains bristlegrass, and Arizona cottontop. Invaders are gummy lovegrass, tumblegrass, red lovegrass, yucca, and mesquite. Shin oak and sand sagebrush were minor components of the original plant community, but prolonged heavy use of the range has destroyed the competing plants, and the oak and sagebrush now constitute a large proportion of the vegetation.

Preliminary data indicate that the potential herbage yield varies between 4,000 pounds per acre in favorable years and 2,400 pounds per acre in unfavorable years.

MIXED LAND SITE

This site occupies gently sloping to steep uplands characterized by rolling hills and well-defined drainage patterns. The drainageways are generally well covered with vegetation. The soils in this site are—

Enterprise very fine sandy loam, 0 to 1 percent slopes.
Enterprise very fine sandy loam, 1 to 3 percent slopes.
Enterprise very fine sandy loam, 3 to 5 percent slopes.
Tipton silt loam.

Decreasers in the potential plant community include side-oats grama, Arizona cottontop, plains bristlegrass, western wheatgrass, and vine-mesquite. Increasers are blue grama, buffalograss (fig. 35), hairy grama, tall drop-

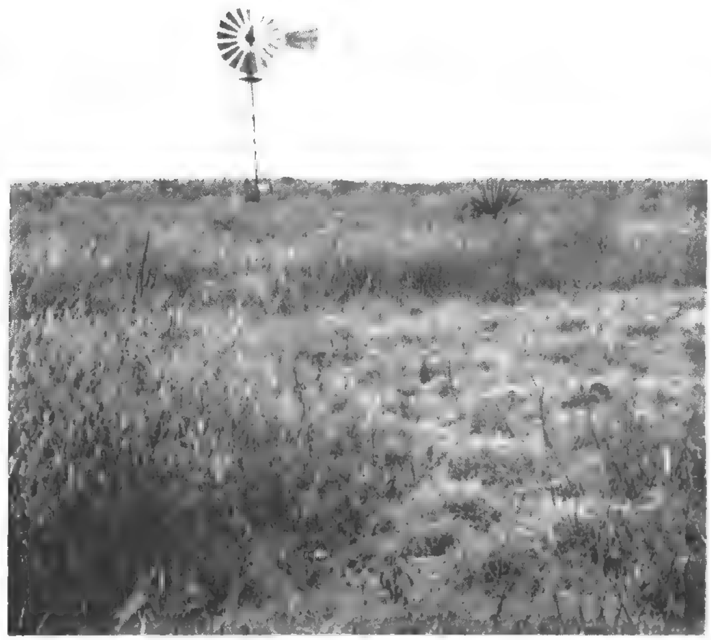

Figure 35.—**Mixed Land range site in good condition. Predominant grasses are blue grama and buffalograss.**

seed, and silver bluestem. Common invaders are Texas grama, sand muhly, red grama, hairy tridens, mesquite, condalia, tasajillo, pricklypear, and annuals. Little bluestem and sand bluestem grow where the soils contain gypsum.

Preliminary data indicate that the potential herbage yield of this site varies between 3,400 pounds per acre in favorable years and 1,900 pounds per acre in unfavorable years.

GRAVELLY SITE

This site occupies gently rolling to steep hills, the surface of which is "paved" with gravel. It consists entirely of Gravelly rough land.

This site produces a wide variety of vegetation, generally including a moderate to heavy stand of black grama. It is therefore a desirable site for wintering livestock. Decreases in the potential plant community include side-oats grama, blue grama, little bluestem, black grama, and Arizona cottontop. Some sand bluestem, Indiangrass, and switchgrass occur where growing conditions are most favorable. Increasers include hairy grama, buffalograss, silver bluestem, Texas wintergrass, and small amounts of shin oak. Common invaders are Texas grama, sand muhly, hairy tridens, fall witchgrass, mesquite, catclaw, pricklypear, and numerous annuals.

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Preliminary data indicate that the potential herbage yield of this site varies between 2,800 pounds per acre in favorable years and 1,400 pounds per acre in unfavorable years.

VERY SHALLOW SITE

This site occupies rolling to hilly uplands and in places includes knolls and fairly steep escarpments. It consists entirely of Ector soils. In this county, Ector soils are mapped both separately and as parts of two different complexes: (1) the La Casa-Ector complex and (2) the Cottonwood-Ector-Vernon complex.

Overall, this is a mid-grass site, but tall grasses grow on the lower parts of slopes where the soils are deeper and receive runoff occasionally. Decreases include side-oats, grama, little bluestem, and blue grama (fig. 36).

Figure 36.—Good cover of side-oats grama, hairy grama, and little bluestem on Very Shallow range site.

Increasers are buffalograss, hairy grama, silver bluestem, slim tridens, and black grama. Invaders include hairy tridens, sand dropseed, Texas grama, red grama, sand muhly, mesquite, pricklypear, condalia, yucca, redberry juniper, and annuals.

Preliminary data indicate that the potential herbage yield of this site varies between 2,300 pounds per acre in favorable years and 1,000 pounds per acre in unfavorable years.

SHALLOW REDLAND SITE

This site occurs on the uplands. The topgraphy ranges from gently sloping terrain to rolling hills and ridges. The site consists entirely of Vernon soils. In this county, Vernon soils are mapped with the Weymouth soils and as parts of three other complexes: (1) the Vernon-badland complex, (2) the Cottonwood-Vernon-Acme complex, and (3) the Cottonwood-Ector-Vernon complex.

Overall, this is a short-grass site, but some mid grasses grow in areas where there is adequate moisture. Decreasers are blue grama, side-oats grama, and vine-mesquite. Increasers are buffalograss, tobosa, hairy grama, and silver bluestem. Invaders are hairy tridens, sand muhly, Texas grama, red grama, mesquite, pricklypear, redberry juniper, and annuals.

Preliminary data indicate that the potential herbage yield of this site varies between 2,500 pounds per acre in favorable years and 1,350 pounds per acre in unfavorable years.

CLAY FLATS SITE

This site occurs as alluvial flats, in places surrounded by or adjacent to higher lying hills. It consists entirely of Miller clay.

The original climax decreasers were side-oats grama, blue grama, western wheatgrass, white tridens, and vine-mesquite. Increasers were tobosa and buffalograss and, in the saline areas, alkali sacaton. The invaders are mesquite, cholla cactus, lotebush, and annuals.

Continued heavy grazing of the climax vegetation has reduced the density of the decreasers. Tobosa, an aggressive increaser, has spread rapidly and now is predominant.

Preliminary data indicate that the potential herbage yield of this site varies between 2,800 pounds per acre in favorable years and 1,700 pounds per acre in unfavorable years.

Controlled grazing

The Sandy Land and Deep Sand sites, when producing climax vegetation, are best suited to spring and summer use because the tall grasses are less palatable and less nutritious during winter months. These sandy sites are highly susceptible to wind erosion when they are bare of vegetation. It is important therefore that they be protected at all times.

All other range sites in the county in good or excellent condition are suitable for use at any season or the year long. They are thus subject to overuse and deterioration. All ranges in the county respond to the basic principles of range management, namely, the proper degree of grazing use to maintain plant growth; the selection of the kind of livestock best suited to the range; the necessary seasonal adjustments in the grazing use to maintain plant growth; the selection of the kind of livestock best suited to the range; the necessary seasonal adjustments in the grazing program to make best use of seasonally palatable plants and to prevent overuse of any part of the range; and the distribution of livestock over the range to insure uniform and proper use of all the range. As the range condition deteriorates, these management practices may need to be supplemented with other measures, such as deferred grazing, brush control, water control, and, in the most severe conditions, seeding.

Field Windbreaks

Field windbreaks help to reduce soil blowing, to control snow drifting, to conserve moisture, and to protect crops, orchards, livestock, and wildlife.

The first windbreak plantings in Foard County were made in 1936. In the next 7 years, under the direction

of the Forest Service of the U.S. Department of Agriculture, about 38 miles of windbreaks were planted in a patchwork pattern, both east-west and north-south, mainly along land survey lines. From 1937 on, the Soil Conservation Service cooperated with the soil conservation districts in establishing field and farmstead windbreaks on farms cooperating in a complete soil conservation program. In 1942, the responsibility for the program was transferred to the Soil Conservation Service.

There are in the county approximately 150,000 acres of deep, sandy soils that are moderately to highly susceptible to wind erosion and are suitable for field windbreak plantings. These soils are the Miles fine sandy loams, Miles loamy fine sand, the Enterprise very fine sandy loams, the Enterprise fine sandy loams, the Springer loamy fine sands, and Tipton silt loam. All of these soils readily absorb moisture and have a friable root zone that is 6 to 20 feet thick.

The Enterprise and Tipton soils are nearly level and ordinarily have high natural fertility. They are the most productive soils in the county for trees. The Miles fine sandy loams and Miles loamy fine sand rank next. Trees grown on the Miles soils ordinarily attain at maturity a height of 5 to 10 feet less than do trees grown on the Enterprise or Tipton soils. The sandy Springer soils are almost as productive for trees as the Miles soils (see table 3).

TABLE 3.—*Expected average height of suitable trees or shrubs on selected sandy soils*

[Dashes indicate that the tree or shrub is not grown on the particular soil]

Species	Springer loamy fine sands			Miles loamy fine sand			Miles fine sandy loams		
	Age in years			Age in years			Age in years		
	5	10	20	5	10	20	5	10	20
	Feet	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*	*Feet*
Shortleaf pine	6	[1]20	35	7	22	40	7	20	38
Loblolly pine	7	23	[1]41	8	24	[1]45	8	22	40
Eastern redcedar	4	[1]15	28	5	17	[1]31	4	16	[1]29
Ailanthus	----	----	----	8	21	[1]36	----	----	----
Siberian elm	11	33	[1]50	12	35	55	9	30	[1]46
Cottonwood	13	37	[1]57	----	----	----	10	33	50
Sycamore	----	----	----	10	22	[1]45	----	----	----
Osage-orange	7	16	[1]24	----	----	----	7	14	[1]22
Russian mulberry	8	21	[1]31	8	23	[1]36	----	----	----
Green ash	7	17	[1]24	9	24	[1]36	----	----	----
Desertwillow	5	10	[1]13	----	----	----	6	12	[1]16
Russian-olive	5	11	[1]15	----	----	----	----	----	----
Apricot	4	8	[1]15	4	9	[1]17	4	8	[1]16
Catalpa	6	12	[1]24	----	----	----	----	----	----
Bur oak	4	11	[1]23	----	----	----	----	----	----
Black walnut	4	17	[1]27	5	20	[1]36	----	----	----
Hackberry	----	----	----	7	22	[1]40	----	----	----

[1] Height determined by actual measurement in field.

Trees will grow satisfactorily on all these soils if hardy planting stock of suitable species is carefully selected, correctly planted, properly cared for, and protected from fire. Windbreak plantings, regardless of their age, should be protected from livestock.

Two general factors must be considered in locating windbreaks. They are the direction of the prevailing winds during the season of greatest wind damage and the direction of the slope.

On level to gently sloping soils, windbreaks may be planted in straight lines (fig. 37). A combination of east-west and north-south belts is most effective if the slope in the direction of the belt does not exceed 3 percent. On rolling land, windbreaks should be planted on the contour, provided the contour lines generally are at right angles to the direction of the prevailing wind.

Figure 37.—**Typical view of windbreak plantings on Miles loamy fine sand.**

Isolated east-west or north-south windbreaks offer little protection in proportion to the space they occupy. A two-direction pattern, in which the belts of trees are at right angles and are properly spaced, generally is almost twice as effective as a single isolated belt. Quartering winds further reduce the effectiveness of a single isolated belt.

Field windbreaks supplement other conservation practices in protecting soils against wind erosion; they will not do the job alone. They should be high enough to protect the soils and crops between the belts and dense enough to provide an effective drag on the wind. They should have horizontal and vertical continuity.

A three-row windbreak is the most practical and feasible. A maximum of five rows is generally adequate, but a wider windbreak may be needed for full protection. At least one row should be of evergreens, or conifers, to furnish maximum protection in winter and in spring.

Information on planning and laying out windbreak plantings can be obtained from local tree specialists, a technician of the Soil Conservation Service, or the county agent.

Engineering Uses of the Soils [3]

Some soil properties are of special interest to engineers because they affect the construction and maintenance of roads, airports, pipelines, building foundations, facilities for water storage, erosion control structures, drainage systems, and sewage disposal systems. The properties most important to the engineer are permeability to water, shear strength, compaction characteristics, soil drainage, shrink-swell characteristics, grain size, plasticity, and pH. Depth to water table, depth to bedrock, and topography also are important.

Information in this report can be used to—

1. Make soil and land use studies that will aid in the selection and development of industrial, business, residential, and recreational sites.
2. Make preliminary estimates of the engineering properties of soils in planning agricultural drainage systems, farm ponds, irrigation systems, and other soil and water conservation structures.
3. Make preliminary evaluations of soil and ground conditions that will aid in locating highways and airports and in planning detailed soil surveys at the selected locations.
4. Locate sources of topsoil and other construction material.
5. Correlate performance of engineering structures with soil mapping units and thus develop information that will be useful in designing and maintaining such structures.
6. Determine the suitability of soils for cross-country movement of vehicles and construction equipment.
7. Supplement information obtained from other published maps and reports and aerial photographs, for the purpose of making maps and reports that can be used readily by engineers.
8. Select locations for pipelines.
9. Develop for construction purposes other preliminary estimates pertinent to the particular area.

This report will not eliminate the need for on-site sampling and testing of soils for design and construction of specific engineering works. It should be used primarily in planning more detailed field investigations to determine the condition of soil material in place at the proposed site.

Some terms used by the soil scientist may be unfamiliar to engineers. These and other terms used in this report are defined in the Glossary.

[3] Prepared by WILLIAM C. TATE, area engineer, Soil Conservation Service, Vernon, Tex.

TABLE 4.—*Estimated*

[Dashes indicate that properties are not estimated

Map symbol	Soil	Description	Depth from surface	Classification
				USDA textural class
			Inches	
AbA AbB AbB2	Abilene clay loam, 0 to 1 percent slopes. Abilene clay loam, 1 to 3 percent slopes. Abilene clay loam, 1 to 3 percent slopes, eroded.	Loamy, calcareous, outwash deposits of the Quaternary and Tertiary periods; high, nearly level, broad plains dissected by deep, natural drainageways.	0 to 6	Clay loam
			6 to 12	Silty clay loam
			12 to 24	Heavy silty clay loam
			24 to 56	Heavy silty clay loam
			56 to 84+	Clay loam
Ak	Abilene-slickspot complex.	Developed from calcareous, clayey, outwash deposits; nearly level, concave slopes; occurs along small drains; complex consists of Abilene clay loam intermixed with alkali spots that are high in salts. Properties of slickspot soils described here. For properties of Abilene soils, see description of Abilene clay loams.	0 to 6	Clay loam
			6 to 9	Heavy silty clay loam
			9 to 27	Heavy clay loam
			27 to 40	Clay
			40 to 50+	Silty clay loam
Am	Altus fine sandy loam.	Moderately coarse textured soils formed in moderately sandy earths of outwash deposits; occur within Reddish Chestnut soil zone; nearly level, (slopes of about 0.5 percent); weakly concave.	0 to 8	Fine sandy loam
			8 to 20	Light sandy clay loam
			20 to 27	Sandy clay loam
			27 to 48	Heavy clay loam
			48 to 65+	Heavy clay loam
CoB	Cobb fine sandy loam, 1 to 3 percent slopes.	Moderately permeable soils developed in the noncalcareous, fine-grained sandstone formation of the Clear Fork group of the Permian system; convex slopes of about 1.8 percent; low to medium plasticity.	0 to 6	Fine sandy loam
			6 to 10	Light sandy clay loam
			10 to 34	Sandy clay loam
			34 to 40+	Soft sandstone
Cs	Cobb fine sandy loam, shallow variant.	Convex slopes averaging about 4 percent; otherwise, same as Cobb fine sandy loam.	0 to 5	Fine sandy loam
			5 to 16	Sandy clay loam
			16 to 24+	Sandstone

Engineering classification systems

Two systems of classifying soils, the AASHO and Unified, are in general use among engineers. Both are used in this report.

Most highway engineers classify soil material according to the system approved by the American Association of State Highway Officials (*1*). In this system the soils are classified in seven principal groups. The groups range from A–1, which consists of gravelly soils of high bearing capacity, to A–7, which consists of clay soils having low strength when wet.

Some engineers prefer to use the Unified soil classification system (*12*). In this system, soil material is divided into 15 classes. Eight classes are for coarse-grained material (GW, GP, GM, GC, SW, SP, SM, SC), six for fine-grained material (ML, GL, OL, MH, CH, OH), and one for highly organic material (Pt). Mechanical analysis is used to identify the GW, GP, SW, and SP classes of material; and mechanical analysis, liquid limit, and plasticity index are used to determine the GM, GC, SM, SC classes, and all of the classes of fine-grained material.

The classifications of the soils of Foard County according to both the AASHO and Unified systems are given in table 4.

Estimated properties of soils

Brief descriptions of the soils in Foard County and estimates of their physical and chemical properties are given in table 4. The Unified and AASHO classifications for the Abilene, Miles, and Springer soils are based on data furnished by the Bureau of Public Roads for those soils in Wilbarger County, Tex. The classifications for the Hollister, Randall, Tillman, and Vernon soils are based on data furnished by the Bureau of Public Roads for those soils in Haskell County, Tex. The classifications for the other soils are based on field tests.

The column headed "Permeability" indicates the rate at which water will move through soil material that is not compacted; it is measured in inches per hour. The column headed "Available water capacity" gives estimates of the amount of capillary water in the soil when it is wet to field capacity. It is measured in inches per inch of soil depth. Field capacity is the amount of water the soil will hold after all excess moisture has percolated downward. The estimates for permeability and available water capacity are particularly significant in planning irrigation and drainage systems.

No estimates are given for properties of the land types in Foard County.

properties of soils

or that reliable information is not available]

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200				
					In. per hr.	*In. per in. of soil*	*pH*	
CL	A–6	100	95 to 100	80 to 85	0. 5 to 0. 8	0. 14 to 0. 20	6. 8 to 7. 3	Moderate.
CL	A–6	100	100	85 to 90	0. 2 to 0. 5	0. 14 to 0. 20	7. 0 to 7. 5	Moderate.
CL	A–7	100	100	90 to 95	0. 2 to 0. 5	0. 16 to 0. 20	7. 0 to 7. 5	Moderate.
CL	A–7	100	100	90 to 95	0. 2 to 0. 5	0. 16 to 0. 20	7. 4 to 7. 9	Moderate.
CL	A–6	100	100	85 to 90	0. 2 to 0. 5	0. 16 to 0. 20	7. 8 to 8. 3	Moderate.
CL	A–6	100	95 to 100	80 to 85	0. 5 to 0. 8	0. 14 to 0. 20	7. 2 to 7. 7	Moderate.
CL	A–7	100	100	90 to 95	0. 2 to 0. 5	0. 16 to 0. 20	7. 2 to 7. 7	Moderate.
CL	A–7	100	100	90 to 95	0. 2 to 0. 5	0. 16 to 0. 20	7. 8 to 8. 3	Moderate.
CH	A–7	100	100	90 to 95	0. 2 to 0. 5	0. 16 to 0. 20	8. 0 to 8. 5	High.
CL	A–6	100	100	85 to 90	0. 2 to 0. 5	0. 16 to 0. 20	8. 0 to 8. 5	Moderate.
SM	A–4	100	95 to 100	35 to 40	0. 8 to 2. 5	0. 10 to 0. 14	6. 2 to 6. 7	Low.
SC, SM	A–2, A–4	100	100	35 to 45	1. 0 to 1. 5	0. 14 to 0. 18	6. 8 to 7. 3	Moderate.
CL, CH	A–6, A–7	100	100	80 to 85	0. 5 to 0. 8	0. 14 to 0. 20	7. 0 to 7. 5	Moderate to high.
CL, CH	A–6, A–7	100	100	80 to 85	0. 5 to 0. 8	0. 14 to 0. 20	7. 0 to 7. 5	Moderate to high.
CL, CH	A–6, A–7	100	100	90 to 95	0. 2 to 0. 5	0. 16 to 0. 20	7. 7 to 8. 2	Moderate to high.
SM	A–4	100	95 to 100	35 to 40	0. 8 to 2. 5	0. 10 to 0. 14	6. 8 to 7. 3	Low.
SC	A–2	100	100	30 to 35	1. 0 to 1. 5	0. 14 to 0. 18	6. 8 to 7. 3	Moderate.
SC, SM–SC	A–4, A–6	100	100	40 to 50	1. 0 to 1. 5	0. 14 to 0. 18	6. 8 to 7. 3	Moderate.
SM	A–4	100	95 to 100	35 to 40	0. 8 to 2. 5	0. 10 to 0. 14	6. 8 to 7. 3	Low.
SC, SM–SC	A–2, A–6	100	100	30 to 50	1. 0 to 1. 5	0. 14 to 0. 18	6. 8 to 7. 3	Moderate.

TABLE 4.—*Estimated*

Map symbol	Soil	Description	Depth from surface	Classification
				USDA textural class
			Inches	
Cu	Cobb-Quinlan complex.	Properties of Quinlan soils described here. For properties of Cobb soils, see description of Cobb fine sandy loam, shallow variant.	0 to 6 6 to 13 13 to 18	Fine sandy loam Fine sandy loam Permian sandstone
Cw	Cottonwood-Acme complex.	Cottonwood: Lithosol developed over calcareous gypsum; moderate plasticity in upper 4 inches.	0 to 4 4 to 12+	Clay loam Gypsum material
		Acme: Moderately permeable, shallow soils developed in calcareous gypsum.	0 to 6 6 to 18 18 to 40+	Clay loam Clay loam Weathered gypsum
Cx	Cottonwood-Ector-Vernon complex.	For properties of Cottonwood soils, see description of Cottonwood-Acme complex. For properties of Ector soils, see description of Ector soils. For properties of Vernon soils, see description of Vernon-badland complex.		
Cy	Cottonwood-Vernon-Acme complex.	For properties of Cottonwood and Acme soils, see description of Cottonwood-Acme complex. For properties of Vernon soils, see description of Vernon-badland complex.		
Ec	Ector soils.	Calcareous Lithosols in Reddish Chestnut zone; developed from Permian dolomitic limestone, 6 inches to several feet thick; about 5 inches of soil over dolomitic limestone.	0 to 5 5 to 12+	Loam Dolomitic limestone
EfA EfB	Enterprise fine sandy loam, 0 to 1 percent slopes. Enterprise fine sandy loam, 1 to 3 percent slopes.	Granular fine sandy loams developed in wind-deposited very fine sands adjacent to the Pease River.	0 to 8 8 to 14 14 to 58 58 to 70+	Fine sandy loam Fine sandy loam Fine sandy loam Light sandy clay loam
EnA EnB EnC	Enterprise very fine sandy loam, 0 to 1 percent slopes. Enterprise very fine sandy loam, 1 to 3 percent slopes. Enterprise very fine sandy loam, 3 to 5 percent slopes.	Sands and silty sands; wind deposited; poorly graded; topography gently rolling with level to slightly concave single slopes; low plasticity.	0 to 8 8 to 18 18 to 65 65 to 75+	Very fine sandy loam Very fine sandy loam Very fine sandy loam Very fine sandy loam
Gr	Gravelly rough land.	Soil material is fine sandy loam about 24 inches in depth; 20 to 60 percent of material is waterworn gravel.	----------	----------
HcA HcB HcB2	Hollister clay loam, 0 to 1 percent slopes. Hollister clay loam, 1 to 3 percent slopes. Hollister clay loam, 1 to 3 percent slopes, eroded.	Inorganic clays and clay-silt mixtures derived from Permian clays and shales; topography smooth to nearly level; convex slopes, medium to high plasticity.	0 to 6 6 to 11 11 to 20 20 to 48 48 to 58 58 to 84 84 to 90+	Clay loam Heavy clay loam Clay Clay Clay Clay Red-bed clay
LaB	La Casa clay loam, 1 to 3 percent slopes.	Silt-clay mixtures derived from strongly calcareous Permian clays and dolomitic limestone; topography gently sloping; convex slopes; medium to high plasticity.	0 to 6 6 to 10 10 to 36 36 to 72+	Clay loam Silty clay loam Silty clay loam Light clay loam
Lc	La Casa-Ector complex.	For properties of La Casa soils, see description of La Casa clay loam. For properties of Ector soils, see description of Ector soils.		

properties of soils—Continued

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200				
					In. per hr.	*In. per in. of soil*	*pH*	
SM	A–4	100	95 to 100	35 to 40	0. 8 to 2. 5	0. 12 to 0. 16	6. 8 to 7. 3	Low.
SM	A–4	100	95 to 100	35 to 40	0. 8 to 2. 5	0. 12 to 0. 16	6. 8 to 7. 3	Low.
CL	A–6	100	95 to 100	80 to 85	0. 5 to 0. 8	0. 14 to 0. 20	6. 8 to 7. 3	Moderate.
CL	A–6	100	95 to 100	80 to 85	0. 5 to 0. 8	0. 14 to 0. 20	7. 7 to 8. 0	Moderate to high.
CL	A–6	100	95 to 100	85 to 90	0. 5 to 0. 8	0. 14 to 0. 20	7. 7 to 8. 0	Moderate to high.
CL, ML-CL	A–4, A–6	100	95 to 100	75 to 80	0.5 to 0.8	0.14 to 0.20	6.8 to 7.3	Low.
SM	A–2	100	75 to 80	30 to 35	1.5 to 2.5	0.12 to 0.16	7.3 to 7.8	Low.
SM	A–2	100	75 to 80	30 to 35	1.5 to 2.5	0.12 to 0.16	7.3 to 7.8	Low.
SM	A–2	100	75 to 80	30 to 35	1.5 to 2.5	0.12 to 0.16	7.8 to 8.3	Low.
SM, SC	A–4	100	95 to 100	45 to 50	1.0 to 2.0	0.14 to 0.18	7.8 to 8.3	Low.
ML	A–4	100	80 to 85	60 to 65	0. 8 to 2. 5	0. 12 to 0. 20	7. 2 to 7. 8	Low.
ML	A–4	100	80 to 85	60 to 65	0. 8 to 2. 5	0. 12 to 0. 20	7. 5 to 8. 0	Low.
ML	A–4	100	80 to 85	60 to 65	0. 8 to 2. 5	0. 12 to 0. 20	7. 8 to 8. 3	Low.
ML	A–4	100	80 to 85	60 to 65	0. 8 to 2. 5	0. 12 to 0. 20	7. 8 to 8. 3	Low.
CL	A–6	100	95 to 100	80 to 85	0. 5 to 0. 8	0. 14 to 0. 18	7. 3 to 7. 8	Moderate.
CL, CH	A–7–6	100	100	85 to 95	0. 2 to 0. 5	0. 16 to 0. 20	7. 3 to 7. 8	High.
CH	A–7–6	100	100	90 to 95	0. 2 to 0. 5	0. 16 to 0. 20	7. 5 to 8. 0	High.
CH	A–7–6	100	100	90 to 95	0. 2 to 0. 5	0. 16 to 0. 20	7. 8 to 8. 3	High.
CH	A–7–6	100	100	90 to 95	0. 2 to 0. 5	0. 16 to 0. 20	7. 8 to 8. 3	High.
CL, CH	A–6, A–7	100	95 to 100	85 to 90	0. 2 to 0. 5	0. 16 to 0. 20	7. 8 to 8. 3	Moderate to high.
CH	A–7	100	95 to 100	85 to 90	0. 05 to 0. 2	0. 16 to 0. 20	7. 8 to 8. 3	High.
CL	A–6	100	95 to 100	80 to 85	0. 5 to 0. 8	0. 13 to 0. 20	7. 3 to 7. 8	Moderate.
CL, CH	A–6, A–7	100	100	85 to 90	0. 2 to 0. 5	0. 13 to 0. 20	7. 3 to 7. 8	Moderate to high.
CL, CH	A–6, A–7	100	100	85 to 90	0. 2 to 0. 5	0. 13 to 0. 20	7. 3 to 7. 8	Moderate to high.
CL	A–6	100	100	80 to 85	0. 2 to 0. 5	0. 13 to 0. 20	7. 8 to 8. 3	Moderate.

TABLE 4.—*Estimated*

Map symbol	Soil	Description	Depth from surface	Classification
				USDA textural class
			Inches	
Lo	Loamy alluvial land.	Stratified layers of clay, silty clay loam, clay loam, silt loam, loam, and fine sandy loam.	----------	----------
MFA MfB MFC	Miles fine sandy loam, 0 to 1 percent slopes. Miles fine sandy loam, 1 to 3 percent slopes. Miles fine sandy loam, 3 to 5 percent slopes.	Silty sands or silt-sand mixtures developed in sandy earths of plains outwash or old alluvium of the Quaternary and Tertiary periods; topography gently rolling to nearly level; convex slopes; low plasticity.	0 to 8 8 to 13 13 to 30 30 to 52 52 to 65+	Fine sandy loam Heavy, fine, light sandy loam Sandy clay loam Light sandy clay loam Fine sandy loam
MmB	Miles loamy fine sand, 0 to 3 percent slopes.	Silty sands or silt-sand mixtures developed in sandy earths of plains outwash or old alluvium of the Quaternary and Tertiary periods; topography gently rolling to nearly level; convex slopes; low plasticity.	0 to 18 18 to 23 23 to 30 30 to 60+	Loamy fine sand Sandy clay loam Heavy sandy clay loam Heavy clay loam
Mr	Miller clay.	Alluvial soils in Reddish Chestnut zone; developed in alluvial sediments of red beds; topography nearly level; high plasticity.	0 to 24 24 to 42 42 to 50+	Clay Heavy clay loam Heavy silty clay loam
Ra	Randall clay.	Very slowly permeable Grumusols on floors of enclosed depressions; formed from clayey outwash of Abilene and Vernon soils; topography level; high plasticity.	0 to 6 6 to 60	Clay Clay
Sa	Sandy alluvial land.	Stratified	----------	----------
Sg Sp	Springer loamy fine sand, undulating. Springer loamy fine sand, hummocky.	Noncalcareous soils in Reddish Brown zone; developed in sandy earths of plains outwash or old alluvium of the Quaternary period; topography gently sloping, slopes average 2 percent; low plasticity.	0 to 16 16 to 22 22 to 36 36 to 48+	Loamy fine sand Fine sandy loam Heavy fine sandy loam Heavy sandy clay loam
Sr	Spur silt loam.	Calcareous Alluvial soils in Reddish Chestnut zone; developed in alluvial sediments of the red beds; 0 to 1 percent slopes; low to medium plasticity.	0 to 6 6 to 18 18 to 60+	Silt loam Silty clay loam Light silty clay loam
Su	Spur clay loam.	Calcareous Alluvial soils in Reddish Chestnut zone; developed in loamy sediments of Permian red beds; topography nearly level; slopes less than 0.5 percent; medium plasticity.	0 to 6 6 to 20 20 to 60+	Clay loam Silty clay loam Light silty clay loam
Sy	Spur and Miller clay loams.	Alluvial soils in Reddish Chestnut zone; developed in alluvial sediments of the red beds; slopes generally less than 0.5 percent; high plasticity. Properties of Miller clay loam described here. For properties of Spur soils, see description of Spur clay loam.	0 to 6 6 to 22 22 to 60+	Clay loam Clay loam Clay
TcA TcB TcB2	Tillman clay loam, 0 to 1 percent slopes. Tillman clay loam, 1 to 3 percent slopes. Tillman clay loam, 1 to 3 percent slopes, eroded.	Very slowly permeable, reddish-brown Reddish Chestnut soils developed in clays and shales of Permian red beds; gently rolling topography; slopes convex, 1.5 to 2.5 percent; high plasticity.	0 to 5 5 to 11 11 to 20 20 to 34 34 to 39 39 to 46 46 to 62+	Clay loam Light clay Clay Clay Clay Clay Red-bed clay

properties of soils—Continued

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200				
					In. per hr.	*In. per in. of soil*	*pH*	
SM	A 4	100	95 to 100	35 to 40	1. 0 to 2. 5	0. 08 to 0. 16	6. 8 to 7. 3	Low.
SC, SM-SC	A-2	100	95 to 100	30 to 35	0. 8 to 2. 5	0. 12 to 0. 20	6. 8 to 7. 3	Moderate.
SC, SM-SC	A-4, A-6	100	95 to 100	45 to 50	0. 8 to 2. 5	0. 12 to 0. 20	7. 0 to 7. 5	Moderate.
SC, SM-SC	A-4, A-6	100	95 to 100	45 to 50	0. 8 to 2. 5	0. 12 to 0.20	7. 0 to 7. 5	Moderate.
SM	A-4	100	95 to 100	35 to 40	1. 0 to 2. 5	0. 08 to 0. 16	7. 0 to 7. 5	Low.
SM	A-2	100	100	25 to 30	1. 5 to 2. 5	0. 10 to 0. 14	6. 2 to 6. 7	Low.
SC, SM-SC	A-2, A-4	100	100	35 to 40	1. 0 to 2. 0	0. 12 to 0. 16	6. 8 to 7. 3	Moderate.
CL	A-4, A-6	100	100	70 to 75	0. 8 to 1. 5	0. 12 to 0. 18	6. 8 to 7. 3	Moderate.
CL, CH	A-6, A-7	100	100	85 to 95	0. 5 to 1. 0	0. 15 to 0. 20	6. 8 to 7. 3	High.
CL, CH	A-7	100	100	85 to 95	0. 05 to 0. 2	0. 18 to 0. 20	7. 3 to 7. 8	High.
CL, CH	A-7	100	100	85 to 90	0. 2 to 0. 5	0. 14 to 0. 20	7. 3 to 7. 8	High.
CL, CH	A-7	100	100	85 to 95	0. 05 to 0. 2	0. 16 to 0. 20	7. 8 to 8. 3	High.
CL, CH	A-6, A-7	100	100	95 to 100	0. 05 to 0. 2	0. 18 to 0. 20	7. 3 to 7. 8	High.
CL, CH	A-6, A-7	100	100	95 to 100	0. 05 to 0. 2	0. 18 to 0. 20	7. 8 to 8. 3	High.
SM	A-2	100	100	15 to 20	1. 0 to 2. 5	0. 08 to 0. 14	6. 2 to 6. 7	Low.
SM	A-4	100	100	35 to 40	1. 0 to 2. 5	0. 10 to 0. 18	6. 8 to 7. 3	Low.
SM, SM-SC	A 4	100	100	40 to 45	1. 0 to 2. 5	0. 10 to 0. 18	6. 8 to 7. 3	Low.
CL	A-4, A-6	100	100	70 to 75	0. 5 to 2. 0	0. 12 to 0. 20	6. 8 to 7. 3	Moderate.
ML, CL	A-4	100	100	55 to 65	1. 0 to 2. 0	0. 12 to 0. 20	7. 0 to 7. 5	Moderate.
CL	A-4, A-6	100	100	85 to 90	0. 5 to 2. 0	0. 12 to 0. 20	7. 3 to 7. 8	Moderate.
CL	A-4	100	100	80 to 85	0. 5 to 2. 0	0. 12 to 0. 20	7. 5 to 8. 0	Moderate.
CL	A-4, A-6	100	100	80 to 85	0. 5 to 0. 8	0. 13 to 0. 20	6. 8 to 7. 3	Moderate.
CL	A-4, A-6	100	100	80 to 85	0. 5 to 0. 8	0. 13 to 0. 20	7. 3 to 7. 8	Moderate.
ML, MH	A-4	100	100	80 to 90	0. 5 to 1. 0	0. 13 to 0. 20	7. 5 to 8. 0	Moderate.
CL, CH	A-7	100	100	80 to 85	0. 2 to 0. 5	0. 13 to 0. 20	6. 8 to 7. 3	Moderate to high.
CL, CH	A-7	100	100	80 to 85	0. 2 to 0. 5	0. 13 to 0. 20	7. 3 to 7. 8	Moderate to high.
CL, CH	A-7	100	100	90 to 95	0. 05 to 0. 2	0. 18 to 0. 20	7. 5 to 8. 0	High.
CL	A-6	100	100	80 to 85	0. 2 to 0. 5	0. 13 to 0. 20	6. 8 to 7. 3	Moderate.
CL, CH	A-6, A-7	100	100	80 to 85	0. 05 to 0. 2	0. 16 to 0. 20	7. 0 to 7. 5	High.
CL, CH	A-6, A-7	100	100	85 to 90	0. 05 to 0. 2	0. 18 to 0. 20	7. 3 to 7. 8	High.
CL, CH	A-6, A-7	100	100	85 to 90	0. 05 to 0. 2	0. 18 to 0. 20	7. 3 to 7. 8	High.
CL, CH	A-6, A-7	100	100	85 to 90	0. 05 to 0. 2	0. 18 to 0. 20	7. 3 to 7. 8	High.
CL, CH	A-6, A-7	100	100	85 to 90	0. 05 to 0. 2	0. 18 to 0. 20	7. 8 to 8. 3	High.
CL, CH	A-6, A-7	100	100	90 to 95	0. 05 to 0. 2	0. 18 to 0. 20	7. 8 to 8. 3	High.

TABLE 4.—*Estimated*

Map symbol	Soil	Description	Depth from surface	Classification: USDA textural class
			Inches	
Tp	Tipton silt loam.	Moderately permeable Chestnut soils developed in ancient alluvium along the Pease River; weakly concave slopes of about 0.4 percent; low to moderate plasticity.	0 to 8	Silt loam
			8 to 22	Loam
			22 to 33	Clay loam
			33 to 46+	Heavy clay loam
Tv	Tivoli fine sand.	Immature Regosols that occur in Reddish Chestnut zone; formed in wind-deposited sands of the Quaternary period; hummocky dunes; slopes of 3 to 10 percent; low plasticity.	0 to 8	Fine sand
			8 to 70+	Fine sand
Vb	Vernon-badland complex.	Reddish-brown, shallow and very shallow soils developed in Permian red beds; occur in Reddish Chestnut soil zone; dolomitic limestone, gypsum, and sandstone are occasionally interbedded in this complex; very rough topography. Properties of Vernon clay loam described here. Properties of badland are not estimated.	0 to 5	Clay loam
			5 to 14	Light clay
			14 to 20+	Red-bed clay
VcB VcC	Vernon-Weymouth clay loams, 1 to 3 percent slopes. Vernon-Weymouth clay loams, 3 to 5 percent slopes.	Shallow to very shallow Lithosols that occur in Reddish Chestnut zone; developed in Permian red beds.	0 to 6	Clay loam
			6 to 14	Clay loam
		Properties of Weymouth soils described here.	14 to 22	Clay loam
		For properties of Vernon soils, see description of Vernon-badland complex.	22 to 26+	Red-bed clay
WcB	Wichita clay loam, 1 to 3 percent slopes.	Deep, slowly permeable, brown to reddish soil formed in old alluvial sediments; gently rolling ridges; convex slopes of about 1.8 percent; high plasticity.	0 to 5	Clay loam
			5 to 9	Clay loam
			9 to 22	Heavy clay loam
			22 to 32	Light clay
			32 to 60	Clay loam
			60 to 70+	Clayey red beds
WmA WmB	Wichita loam, 0 to 1 percent slopes. Wichita loam, 1 to 3 percent slopes.	Deep, slowly permeable, brown to reddish-brown soils formed in old alluvial sediments; nearly level plains; slopes about 0.6 percent; medium to high plasticity	0 to 5	Loam
			5 to 9	Clay loam
			9 to 14	Heavy clay loam
			14 to 25	Heavy clay loam
			25 to 42	Heavy clay loam
			42 to 48	Heavy clay loam
			48 to 62+	Sandy clay loam
Ya	Yahola very fine sandy loam.	Calcareous, moderately sandy, brown to reddish-brown Alluvial soils formed in sandy sediments of alluvial origin; alluvial flats with slopes of about 0.4 percent; low plasticity.	0 to 6	Very fine sandy loam
			6 to 24	Very fine sandy loam
			24 to 60	Fine sandy loam

[1] Not determined.

The ratings for shrink-swell potential indicate the volume change to be expected with a change in the moisture content of the soil.

No estimates of salinity or of gypsum content are given in table 4. The slickspots in the Abilene-slickspot complex are the only saline soils in this county; their salinity ranges from 0.35 to 0.60 percent. The Cottonwood soils are the only ones in the county in which the content of gypsum is significant, and in these soils it is very high.

Engineering interpretations of soils

Table 5 outlines the suitability of the soils for various engineering uses. The estimates as to suitability for winter grading and suitability for use as fill, subgrade material, and topsoil are probably those of most interest to highway engineers. The other columns are primarily of interest to conservation engineers.

As indicated in table 5, most of the soils in the county can be graded in winter. The slickspots in the Abilene-

properties of soils—Continued

Classification—Continued		Percentage passing sieve—			Permeability	Available water capacity	Reaction	Shrink-swell potential
Unified	AASHO	No. 4	No. 10	No. 200				
					In. per hr.	*In. per in. of soil*	*pH*	
ML	A-4	100	100	55 to 65	1.0 to 2.0	0.12 to 0.20	6.8 to 7.3	Low.
SC, SM-SC	A-4, A-6	100	100	40 to 45	0.8 to 2.0	0.02 to 0.20	7.0 to 7.5	Moderate.
CL	A-6	100	100	80 to 85	0.8 to 2.0	0.13 to 0.20	7.3 to 7.8	Moderate.
CL, CH	A-7	100	100	85 to 90	0.5 to 2.0	0.16 to 0.20	7.5 to 8.0	High.
SP-SM	A-3	100	95 to 100	5 to 10	2.5 to 5.0	0.06 to 0.08	7.3 to 7.8	Low.
SP-SM	A-3	100	95 to 100	5 to 10	2.5 to 5.0	0.06 to 0.08	7.8 to 8.3	Low.
CL, CH	A-6, A-7	100	100	80 to 85	0.2 to 0.5	0.13 to 0.20	7.2 to 7.7	Moderate.
CL, CH	A-7	100	100	90 to 95	0.05 to 0.2	0.18 to 0.20	7.5 to 8.0	High.
CL, CH	A-7	100	100	80 to 95	0.05 to 0.2	0.18 to 0.20	7.8 to 8.3	High.
CL	A-6	100	100	80 to 85	0.2 to 0.5	0.13 to 0.20	7.2 to 7.7	Moderate.
CL	A-6	100	100	80 to 85	0.2 to 0.5	0.13 to 0.20	7.5 to 8.0	Moderate.
CL	A-6	100	100	80 to 85	0.2 to 0.5	0.13 to 0.20	7.8 to 8.3	Moderate.
CL, CH	A-7	100	100	80 to 95	0.05 to 0.2	0.18 to 0.20	7.8 to 8.3	High.
CL	A-6	100	100	80 to 85	0.2 to 0.5	0.13 to 0.20	6.8 to 7.3	Moderate.
CL, CH	A-6, A-7	100	100	85 to 90	0.2 to 0.5	0.16 to 0.20	6.8 to 7.3	Moderate to high.
CL, CH	A-6, A-7	100	100	85 to 90	0.2 to 0.5	0.16 to 0.20	6.8 to 7.3	Moderate to high.
CL, CH	A-6, A-7	100	100	90 to 95	0.05 to 0.5	0.16 to 0.20	7.4 to 7.9	High.
CL	A-6	100	100	85 to 90	0.2 to 0.5	0.13 to 0.20	7.8 to 8.3	Moderate.
CL, CH	A-6, A-7	100	100	90 to 95	(1)	(1)	(1)	High.
ML	A-4	100	95 to 100	80 to 85	0.8 to 2.5	0.13 to 0.20	6.8 to 7.3	Low.
CL	A-6	100	95 to 100	80 to 85	0.5 to 0.8	0.13 to 0.20	6.8 to 7.3	Moderate.
CL, CH	A-6, A-7	100	100	85 to 90	0.2 to 0.5	0.16 to 0.20	6.8 to 7.3	Moderate to high.
CL, CH	A-6, A-7	100	95 to 100	85 to 90	0.2 to 0.5	0.16 to 0.20	7.3 to 7.8	Moderate to high.
CL, CH	A-6, A-7	100	95 to 100	85 to 90	0.2 to 0.5	0.16 to 0.20	7.3 to 7.8	Moderate to high.
CL, CH	A 6, A-7	100	95 to 100	85 to 90	0.2 to 0.5	0.16 to 0.20	7.5 to 8.0	Moderate to high.
SC	A-4, A-6	100	95 to 100	45 to 50	0.5 to 0.8	0.13 to 0.18	7.5 to 8.0	Moderate.
ML	A-4	100	100	60 to 65	1.0 to 2.0	0.12 to 0.20	6.8 to 7.3	Low.
ML	A-4	100	100	60 to 65	1.0 to 2.0	0.12 to 0.20	7.3 to 7.8	Low.
SM	A-4	100	100	35 to 45	1.0 to 2.0	0.12 to 0.20	7.3 to 7.8	Low.

slickspot complex have a high water table, which interferes with winter grading.

Ratings as to suitability for use as road subgrade are based on the estimated engineering classifications of the soils, as given in table 4. All ratings are for the A and B horizons. If ratings change at any depth, this is noted in the column. Soils of high plasticity and soils that have a highly plastic clay layer, such as Miller clay, the Hollister clay loams, and the Tillman clay loams, have impeded internal drainage and are unstable when wet; hence, they are rated "poor." Silts and loamy fine sands are highly erodible, fine textured, poorly graded, and generally unstable unless properly confined; they are rated "poor" to "fair." Tivoli fine sand has high bearing capacity when confined, and low shrink-swell potential; it is rated "fair to good."

No estimates are given for the land types, which are obviously unsuitable for engineering purposes.

TABLE 5.—*Engineering*

Map symbol	Soil name	Adaptability to winter grading	Suitability of soil for use as— Road subgrade	Suitability of soil for use as— Road fill	Suitability as a source of topsoil	Soil characteristics affecting— Vertical alinement of highways: Materials	Soil characteristics affecting— Vertical alinement of highways: Drainage
AbA AbB AbB2	Abilene clay loam, 0 to 1 percent slopes. Abilene clay loam, 1 to 3 percent slopes. Abilene clay loam, 1 to 3 percent slopes, eroded.	Good	Poor to fair; high shrink-swell potential; poor to fair bearing capacity.	Poor to fair; high shrink-swell potential; moderate to high compressibility and expansion.	Fair	High plasticity	No high water table; impervious substratum.
Ak	Abilene-slickspot complex.[1]	Poor; high water table.	Very poor; high water table; high shrink-swell potential; poor bearing capacity.	Poor; high compressibility and expansion.	Unsuitable	High plasticity	Free water at a depth of approximately 50 inches.
Am	Altus fine sandy loam.	Excellent	Fair to good near surface; poor to fair below depth of approximately 8 inches.	Fair to good; moderate compressibility and expansion.	Fair to good	Good binder; moderate plasticity.	No high water table.
CoB	Cobb fine sandy loam, 1 to 3 percent slopes.	Excellent	Fair near surface; good below depth of approximately 34 inches.	Fair to good; slight to medium compressibility and expansion.	Fair to good	Underlain by sandstone at depth of about 34 inches.	No high water table; impervious substratum.
Cs	Cobb fine sandy loam, shallow variant.	Excellent	Fair near surface; good below depth of approximately 24 inches.	Fair to good; slight to medium compressibility and expansion.	Fair to good.	Underlain by sandstone at depth of about 16 inches.	No high water table; pervious substratum.
Cu	Cobb-Quinlan complex.[2]	Excellent	Fair near surface; good below depth of approximately 14 inches.	Fair; moderate compressibility and expansion.	Fair to good.	Underlain by sandstone at depth of about 16 inches.	No high water table; pervious substratum.
Cw	Cottonwood-Acme complex.[3]	Good	Very poor; high gypsum content; poor bearing capacity.	Very poor; liquefaction likely when wet.	Poor	High gypsum content.	No high water table; excessive seepage and piping likely because of gypsum content.
Cx	Cottonwood-Ector-Vernon complex.[4]						
Cy	Cottonwood-Vernon-Acme complex.[4]						

See footnotes at end of table.

interpretations of soils

Soil characteristics affecting—Continued						
Dikes or levees	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir	Embankment				
Stable with flat slopes; slow permeability.	Very little seepage.	Slow permeability; fairly stable with flat slopes; use for impervious cores and blankets.	Poor internal drainage.	Slow permeability; high water-holding capacity.	Deep soils; slow permeability; will crack.	Deep soils; high water-holding capacity.
Unstable without vegetation; slow permeability.	High water table; high salinity; very little or no seepage.	Poor stability; not suited to vegetation; high dispersion; slow permeability.	High water table (approximately 50 inches below surface).	Slow permeability; high salinity; high water table.	High water table; high salinity.	Will not produce vegetation unless drained.
Fairly stable when used for cores; moderate permeability.	Very little seepage in substratum.	May be used for cores; moderate permeability.	Poor internal drainage below depth of 20 inches.	Slow permeability below depth of 20 inches; high water-holding capacity.	Highly erodible by water and wind.	Highly erodible unless properly protected.
Fairly stable for cores; moderate permeability.	Moderate seepage.	Moderate permeability; fairly stable; use for impervious cores and blankets.	Good internal drainage below depth of 34 inches.	Moderate permeability; shallow soil over sandstone.	Highly erodible.	Satisfactory where little or no excavation is required.
Fairly stable for cores; moderate permeability.	May need to be sealed in sandstone material.	Moderate permeability; not particularly suited to shells but may be used for cores and dikes.	Good internal drainage below depth of approximately 24 inches.	Moderate permeability; shallow over sandstone.	Highly erodible by wind and water.	Limited depth of soil limits vegetative growth.
Fairly stable for cores; moderate permeability.	May need to be sealed in sandstone material.	Moderate permeability with close control; use rubber-tired compaction equipment.	Good internal drainage in sandstone material.	Shallow over sandstone.	Highly erodible by wind and water.	Limited depth of soil limits vegetative growth.
Susceptible to excessive piping.	Excessive seepage and piping because of gypsum content.	Unsuitable because of gypsum content.	Piping likely	Very shallow over gypsum.	Shallow over gypsum.	Will not support adequate vegetation because of gypsum.

TABLE 5.—*Engineering*

Map symbol	Soil name	Adaptability to winter grading	Suitability of soil for use as— Road subgrade	Suitability of soil for use as— Road fill	Suitability as a source of topsoil	Soil characteristics affecting— Vertical alinement of highways: Materials	Soil characteristics affecting— Vertical alinement of highways: Drainage
Ec	Ector soils	Fair to good	Fair at surface; rock below depth of approximately 5 inches; bearing capacity excellent.	Poor to fair; surface layer has medium compressibility and expansion.	Poor; weathered limestone in surface.	Underlain by hard limestone.	Dolomitic limestone rock below depth of 5 feet; impervious substratum.
EfA	Enterprise fine sandy loam, 0 to 1 percent slopes.	Excellent	Fair to good; fair bearing capacity.	Fair to good; very low compressibility and expansion.	Good	Stable, with good binder.	No high water table; moderately permeable substratum.
EfB	Enterprise fine sandy loam, 1 to 3 percent slopes.						
EnA	Enterprise very fine sandy loam, 0 to 1 percent slopes.						
EnB	Enterprise very fine sandy loam, 1 to 3 percent slopes.						
EnC	Enterprise very fine sandy loam, 3 to 5 percent slopes.						
HcA	Hollister clay loam, 0 to 1 percent slopes.	Good	Poor; poor bearing capacity; severe settlement likely under load.	Poor to fair; high compressibility and expansion.	Fair	High plasticity.	No high water table; practically impervious.
HcB	Hollister clay loam, 1 to 3 percent slopes.						
HcB2	Hollister clay loam, 1 to 3 percent slopes, eroded.						
LaB	La Casa clay loam, 1 to 3 percent slopes.	Good	Poor to fair; poor bearing capacity.	Fair to good; medium compressibility and expansion.	Fair	High plasticity.	No high water table; practically impervious.
MfA	Miles fine sandy loam, 0 to 1 percent slopes.	Excellent	Fair to good; good bearing capacity; slight settlement.	Good; low compressibility and expansion.	Fair to good.	Good binder; moderate plasticity.	No high water table; good internal drainage.
MfB	Miles fine sandy loam, 1 to 3 percent slopes.						
MfC	Miles fine sandy loam, 3 to 5 percent slopes.						
MmB	Miles loamy fine sand, 0 to 3 percent slopes.	Excellent	Fair to good near surface; poor below depth of about 28 to 30 inches.	Good near surface; substratum has high compressibility and expansion.	Fair	Erosive binder in surface layers.	No high water table; may have seepage over impermeable substratum.

See footnotes at end of table.

interpretations of soils—Continued

Soil characteristics affecting—Continued						
Dikes or levees	Farm ponds: Reservoir	Farm ponds: Embankment	Agricultural drainage	Irrigation	Terraces and diversions	Waterways
Surface stable; limestone rock below depth of approximately 5 inches; impermeable below 5 inches.	Limestone rock may affect excavation; seepage possible.	Moderate permeability; surface stable below depth of approximately 5 inches; suitable for pervious blankets and shells.	Slow internal drainage; limestone at depth of approximately 5 inches.	Depth of soil approximately 5 inches; low water-holding capacity.	Limestone at depth of approximately 5 inches.	Limited depth of soil limits growth of vegetation; limited depth for excavation.
Fairly stable to stable; moderate permeability.	Excessive seepage.	Moderate permeability; may be used for cores.	Very good internal drainage.	Moderate permeability; gently rolling topography affects surface system designs.	Highly erodible by wind and water.	Deep soils; easily erodible; produce good vegetation.
Stable with flat slopes; slow permeability.	Little or no seepage.	Fairly stable with flat slopes; slow permeability.	Poor internal drainage.	Slow permeability; high water-holding capacity.	High shrink-swell potential may cause erosion by cracking.	Deep soils; subject to cracking.
Fairly stable to stable with flat slopes; moderate permeability.	Little or no seepage.	Fairly stable with flat slopes; use for impervious cores and blankets; moderate permeability.	Fairly good internal drainage.	Moderate permeability and water-holding capacity.	Moderate to high shrink-swell potential; well-graded soil material.	Deep soil; will produce good vegetation.
Moderate permeability; fairly stable with proper controls.	Excessive seepage.	Fairly stable; not suitable for shells but may be used for impervious cores or dikes.	Good internal drainage; easily eroded by water.	Rapid permeability affects surface system designs; complex slopes may affect land leveling; high water table in places.	Susceptible to wind erosion unless adequately protected; susceptible to gully erosion.	Windblown material may accumulate; easily erodible by water.
Moderate permeability; fairly stable with proper controls.	Little seepage in substratum.	Moderate permeability; fairly stable; not suitable for shells but may be used for impervious cores or dikes.	Surface easily eroded by water; poor internal drainage below depth of 28 inches.	Rapid permeability and low water-holding capacity in surface layer.	Susceptible to wind erosion unless protected by vegetation.	Susceptible to wind erosion unless protected by adequate vegetation.

TABLE 5.—*Engineering*

Map symbol	Soil name	Adaptability to winter grading	Suitability of soil for use as— Road subgrade	Suitability of soil for use as— Road fill	Suitability as a source of topsoil	Soil characteristics affecting— Vertical alinement of highways: Materials	Soil characteristics affecting— Vertical alinement of highways: Drainage
Mr	Miller clay	Fair to good.	Poor; low bearing capacity; severe settlement likely under load.	Poor; high compressibility and expansion.	Poor	High plasticity.	Occasionally flooded; no high water table.
Ra	Randall clay	Fair	Poor to very poor; low bearing capacity.	Poor; high compressibility and expansion.	Poor	High plasticity; requires high compaction.	Seasonally flooded; no high water table.
Sg Sp	Springer loamy fine sand, undulating. Springer loamy fine sand, hummocky.	Excellent	Good to fair; fair to high bearing capacity.	Fair; low compressibility and expansion.	Fair	Erosive; low plasticity.	No high water table; good internal drainage.
Sr	Spur silt loam	Good	Fair; low bearing capacity.	Fair; medium compressibility and expansion.	Good	Moderate plasticity.	May be flooded occasionally.
Su	Spur clay loam	Good	Poor to fair; medium bearing capacity.	Poor to fair; medium compressibility and expansion.	Fair	High plasticity	No high water table; may be flooded occasionally.
Sy	Spur and Miller clay loams.[5]	Good	Poor; medium bearing capacity.	Poor; medium compressibility and expansion.	Fair	High plasticity	Occasional flooding; no high water table.
TcA TcB TcB2	Tillman clay loam, 0 to 1 percent slopes. Tillman clay loam, 1 to 3 percent slopes. Tillman clay loam, 1 to 3 percent slopes, eroded.	Good	Poor; low bearing capacity.	Poor; medium to high compressibility and expansion.	Poor to fair	High plasticity	No high water table; slow internal drainage.
Tp	Tipton silt loam	Fair	Poor; low bearing capacity; subject to liquefaction upon wetting.	Poor to fair; medium compressibility and expansion.	Good	Good binder	No high water table.
Tv	Tivoli fine sand	Excellent	Fair to good if confined; high bearing capacity.	Fair; low compressibility and expansion.	Poor to fair	Erosive; low plasticity.	No high water table.

See footnote at end of table.

interpretations of soils—Continued

Soil characteristics affecting—Continued						
Dikes or levees	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir	Embankment				
Very slow permeability; high shrink-swell potential; will crack.	No seepage	Poor stability; high shrink-swell potential; will crack; use with flat slopes; very slow permeability.	Very slow internal drainage.	Very slow permeability; high water-holding capacity.	High shrink-swell potential; will crack when dry.	Very slow permeability; hard to establish vegetation.
Stable with flat slopes; slow permeability.	No seepage	Slow permeability; stable with flat slopes; use for thin cores and blankets.	Slow internal drainage.	Slow permeability; surface drainage needed.	Plastic and sticky when wet; will crack.	Deep soil; difficult to establish vegetation.
Fairly stable to very stable; rapid permeability.	Excessive seepage.	Fairly stable with proper controls; rapid permeability.	Internal drainage; may have deposits of wind erosion.	Low water-holding capacity; rapid permeability.	Not enough soil binder; susceptible to wind erosion if not adequately protected.	Easily erodible; depositions of windblown material.
Poor stability; moderate permeability.	Excessive seepage possible.	Poor stability; not desirable in rolled-fill construction; moderate permeability.	Good internal drainage.	Moderate water-holding capacity and permeability.	Susceptible to wind erosion unless protected by vegetation.	Deep soil; will produce good vegetation; highly erosive unless protected.
Fairly stable with flat slopes; moderate permeability.	Excessive seepage possible.	Fair stability with proper controls; moderate permeability.	Slow internal drainage; weak stratification.	Moderate permeability and water-holding capacity.	Moderate shrink-swell potential; well-graded soil material.	Deep soil; easily eroded if not protected by vegetation.
Fairly stable to stable with flat slopes; slow permeability.	Little or no seepage.	Fairly stable to stable with flat slopes; use for impervious cores and blankets; slow permeability.	Slow internal drainage.	Slow permeability below uppermost 6 inches; high water-holding capacity.	Complex slopes; may be flooded periodically.	Slow permeability; deep soils; overflow a problem if waterways are not parallel to natural drains.
Fairly stable with flat slopes; very slow permeability.	No seepage	High shrink-swell potential; will crack; use for impervious cores; very slow permeability.	Very slow internal drainage.	Slow permeability; high water-holding capacity.	High shrink-swell potential; will crack; plastic and sticky when wet.	Fairly stable.
Fairly stable; moderate permeability.	No seepage	Fairly stable with proper controls; moderate permeability.	Slow internal drainage.	Moderate permeability; moderate water-holding capacity.	Moderate shrink-swell potential; well-graded soil material.	Deep soil; will support good vegetation.
Rapid permeability; fairly stable; may be used in dike sections with flat slopes.	Excessive seepage.	Fairly stable with flat slopes; susceptible to wind erosion; rapid permeability.	Excellent internal drainage.	Rapid permeability affects surface system design; low water-holding capacity.	Susceptible to wind erosion; complex slopes; hummocky; no plasticity.	Windblown material accumulates; easily erodible by water.

TABLE 5.—*Engineering*

Map symbol	Soil name	Adaptability to winter grading	Suitability of soil for use as— Road subgrade	Road fill	Suitability as a source of topsoil	Soil characteristics affecting— Vertical alinement of highways: Materials	Drainage
Vb	Vernon-badland complex.[6]	Fair when dry; poor when wet.	Poor; low bearing capacity.	Poor; high compressibility and expansion.	Poor	Erosive; highly plastic.	No high water table; practically impervious.
VcB VcC	Vernon-Weymouth clay loams, 1 to 3 percent slopes.[7] Vernon-Weymouth clay loams, 3 to 5 pecent slopes.	Good	Poor to fair; medium bearing capacity.	Poor to fair; medium compressibility and expansion.	Fair	Erosive; high plasticity.	No high water table; impervious substratum.
WcB	Wichita clay loam, 1 to 3 percent slopes.	Good	Poor; low bearing capacity.	Poor; high compressibility and expansion.	Fair	High plasticity	No high water table; impervious substratum.
WmA WmB	Wichita loam, 0 to 1 percent slopes. Wichita loam, 1 to 3 percent slopes.	Fair to excellent.	Poor; low bearing capacity.	Poor; high compressibility and expansion.	Fair to good.	High plasticity	No high water table; practically impervious substratum.
Ya	Yahola very fine sandy loam.	Excellent	Poor to fair; medium bearing capacity.	Poor to fair; medium compressibility and expansion.	Good	Good binder	Occasionally flooded; good internal drainage.

[1] Interpretations given here are for slickspot portion of complex. Interpretations for Abilene soils are same as for Abilene clay loams.
[2] Interpretations given here are for Quinlan soils. Interpretations for Cobb soils are same as for Cobb fine sandy loam, shallow variant.
[3] Interpretations given here are for both Cottonwood and Acme soils.
[4] Interpretations for the Cottonwood and Acme soils are given under Cottonwood-Acme complex. Interpretations for Ector soils are given under Ector soils. Interpretations for Vernon soils are given under Vernon-badland complex.

The suitability of a soil for use as road fill depends largely on its natural water content and its texture. Plastic soils, such as Miller clay and Tillman clay loam, are difficult to handle, to compact, and to dry to the desired moisture content; hence, they are rated "poor." The coarser textured soils have a low degree of compressibility and expansion but are difficult to place because they lack the necessary binding material; hence they are rated "poor to fair."

Vertical alinement of roadways is affected by the nature of the soil material and by drainage. Cuts in soils that have highly plastic clay layers, such as Miller clay and the Tillman clay loams, require gentle side slopes because these soils are susceptible to sloughing and sliding on cut slopes. Cuts made into sandy soils, such as Tivoli fine sand, expose highly erodible material to the action of wind and water. Special equipment may be necessary to excavate the dolomitic limestone underlying the Ector soils or the sandstone underlying the Cobb fine sandy loams. A high water table, an impervious substratum,

interpretations of soils—Continued

Soil characteristics affecting—Continued						
Dikes or levees	Farm ponds		Agricultural drainage	Irrigation	Terraces and diversions	Waterways
	Reservoir	Embankment				
Fairly stable with flat slopes; use for blankets and thin cores; slow permeability.	No seepage; may develop gypsum sinkholes.	Poor to fair stability with flat slopes; use for thin cores or blankets; high dispersion; high shrink-swell potential; slow permeability.	Very slow internal drainage.	Slow permeability and rough gullied topography affect surface system design.	Will crack; high shrink-swell potential; susceptible to gully erosion; low permeability.	Rough gullied topography; easily eroded by water; difficult to establish vegetation.
Poor to fair sta-stability with flat slopes; moderate permeability.	No seepage----	Poor to fair stability with flat slopes; use for thin cores or blankets; high dispersion; high shrink-swell potential; moderate permeability.	Slow internal drainage.	Slow permeability; high water-holding capacity.	Fairly stable; high shrink-swell potential.	High shrink-swell potential; easily eroded by water.
Poor to fair stability with flat slopes; slow permeability.	No seepage----	Poor to fair stability with flat slopes; high dispersion; high shrink-swell potential; slow permeability.	Slow internal drainage.	Slow permeability; high water-holding capacity.	Susceptible to gully erosion; plastic and sticky when wet; high shrink-swell potential.	Deep soil; gully erosion may be a problem on steeper slopes.
Poor to fair stability with flat slopes; slow permeability.	No seepage----	Poor to fair stability with flat slopes; use as impervious cores; high shrink-swell potential; slow permeability.	Slow internal drainage below surface layer.	Slow permeability; high water-holding capacity.	High shrink-swell potential; well graded soil material.	High shrink-swell potential; low permeability in substratum; deep soils.
Fairly stable; moderate permeability.	Excessive seepage.	Fairly stable for impervious cores; do not use for shells; moderate permeability.	Good internal drainage.	Moderate to rapid permeability; moderate water-holding capacity.	Easily eroded by wind and water.	Windblown material accumulates; easily eroded by water; may need grade-stabilizing measures at outlets.

[5] Interpretations given here are for Miller clay loam. Interpretations for the Spur portion of this complex are the same as for Spur clay loam.
[6] Interpretations given here are for Vernon soils. No interpretations are given for Badland, which is red-bed shale and clay.
[7] Interpretations given here are for Weymouth soils. Interpretations for Vernon soils are same as for Vernon soils in Vernon-badland complex.

and seasonal floods are all factors that affect vertical alinement. For satisfactory drainage in areas that are occasionally or seasonally flooded and in areas where the water table is high, the pavement surface should be at least 3 feet above ground water. Interceptor ditches on underdrains may be needed where there is surface seepage.

The Tivoli soils and Gravelly rough land are sources of sand and gravel, but the material may require washing and screening. The Springer and Miles loamy fine sands are possible sources of sand and gravel. The Ector soils are underlain by dolomitic limestone, which is suitable for crushing.

Test data, if such data were available, and field experience are the bases for the interpretations relating to dikes and levees, ponds, drainage and irrigation systems, terraces and diversions, and waterways.

Dispersion is not a problem in the clay soils in Foard County.

Genesis, Morphology, and Classification of the Soils

This section describes the factors that are involved in soil formation. It describes the outstanding morphological characteristics of the soils of Foard County and relates them to the factors of soil formation, describes briefly the system of soil classification used in the United States, and shows how the soils in this county have been classified.

Factors of Soil Formation

Soil is a function of climate, living organisms, parent materials, relief, and time. The nature of the soil at any point on the earth depends upon the combination of the five factors at that point. The relative importance of each differs from place to place. In extreme cases one factor may dominate in the formation of the soil and fix most of its properties, as is common when the parent material consists of pure quartz sand. Little can happen to quartz sand, and most soils derived from it usually have faint horizons. Even in quartz sand, however, distinct profiles can form under certain types of vegetation where the topography is low and flat and the water table is high.

The interrelationships among the factors of soil formation are complex, and the effects of any one factor cannot be isolated and identified with certainty. It is convenient, however, to discuss the factors of soil formation separately and to indicate some of their probable effects. The reader should always remember that the factors interact continually in the processes of soil formation and that the interactions are important to the nature of every soil.

Climate

Foard County has a subhumid, warm-temperate, continental type of climate. The Permian rocks have been broken down into residuum, from which soils have formed, by temperature changes and by the action of water. A wetter climate in past geologic ages was responsible for the deposition of the parent material of all the soils formed in outwash and alluvium.

Water has leached calcium carbonate from the profile of the sandy soils and moderately coarse textured soils. In addition, perhaps it leached a large part of the plant nutrients from the root zone. Also, rainwater has moved clay particles downward in the profile.

Wind, too, is an outstanding factor in the development of soils in the area. It deposited sand over the pre-existing Permian red beds. The mantle of eolian material is especially thick along the Pease River.

Living organisms

Before settlement of the county, the native vegetation was most important in the complex of living organisms that affect soil development. The short and mid grasses on the moderately fine textured soils and the tall bunchgrasses on the moderately coarse and coarse textured soils contributed large amounts of organic matter to the soils. This organic matter was derived largely from decaying leaves and stems on the surface and from decaying roots beneath the surface. The decay of these leaves, stems, and roots was brought about by micro-organisms and bacteria.

Many other forms of life began working and churning these soils after they had been enriched with organic matter. Plant roots kept the soils open and porous. Earthworms are the most noticeable form of animal life in the soil. Worm casts and channels occupy about 50 percent of the subsoil of the Tipton soils. Worm casts facilitate the movement of air, water, and plant roots in the soil.

Soil-dwelling rodents have had a part in the development of some soils. Farmers who have occupied the land since it was in native grass know where large prairie-dog towns have thrived. The burrowing of these animals brought limy material to the surface and thus did much to offset the leaching of free lime from the soil. It destroyed soil structure, however.

The influence of man on the soil-forming factors should not be ignored. At first, he fenced the range, overgrazed it, and changed the vegetation. Then, by tilling the land, harvesting crops, and allowing runoff and wind erosion, he has reduced the amount of organic matter and of silt and clay particles in the plow layer. By the use of heavy machinery and by poorly timed tillage, he has compacted the soil and reduced the movement of water, air, and plant roots. He has drastically changed the moisture regime in some areas by irrigating. The changes made by man in the past 60 years have shown marked effects on the soils of the county and will be reflected in the rate of development in the future.

Parent material

The soils of Foard County developed in residuum derived from Permian shale, Permian sandstone, Permian limestone, and Permian gypsum; in sandy and clayey outwash, or ancient alluvium; in recent alluvium; and in recent eolian mantles.

Foard County is underlain by the geological formation known as the Permian red beds, principally by rocks of the Double Mountain group (7). These red beds consist of sediments that, according to geologists, were laid down in an old sea some 200 million years ago. The red beds consist mainly of shale and sandstone interbedded with varying amounts of gypsum and dolomitic limestone.

The soils developed in material derived from Permian shale are nearly level to sloping. The nearly level to gently sloping soils, mainly the Hollister and Tillman soils, are deep and have a dense, compact, clayey subsoil. Most of the gently sloping to moderately sloping soils, of which the Vernon and Weymouth soils are examples, are shallow or very shallow; soil material has been eroded away almost as fast as it has developed.

The soils developed in Permian sandstone are gently sloping to moderately sloping. These are the moderately deep and shallow Cobb and Quinlan soils.

The soils developed in Permian dolomitic limestone are the La Casa, which are ordinarily gently sloping and are moderately deep, and the Ector, which occupy gently sloping to sloping ridges and are very shallow.

The soils developed in gypsum are gently sloping. These are the very shallow Cottonwood and Acme soils. Geologists have indicated that the Permian red beds were exposed until approximately 12 million years ago. At this time the mountains of New Mexico and the Trans-Pecos of Texas were uplifted; rocks were folded, and huge

blocks of the earth's surface were lifted up along lines of great dislocations, or faults. Subsequently, these mountains were severely eroded and a loose mantle of debris was spread over nearly all of Texas. The spreading of this mantle as stream deposits was aided by the gentle tilting of all of the Texas region east of the mountains to the Gulf. These events occurred during the Pliocene and Pleistocene epochs (*8*).

The material that was deposited by the streams is known as outwash, or ancient alluvium. This outwash is of two kinds, sandy and clayey. Miles and Springer soils developed in the sandy outwash, which probably was laid down originally by fast-moving waters and was reworked after deposition by wind into the undulating and hummocky topography. Abilene, Wichita, and Randall soils developed in the clayey outwash, which was deposited by slow-moving water; the clayey particles remained in suspension for longer periods than did the sandy material and formed relatively level plains when deposited. Geologically, the soils that developed in clayey outwash are older than those that developed in sandy outwash.

Soils that are developing in recent alluvium, the Miller, Spur, and Yahola soils, are very young; some of the lower flood plains are reworked continually, and new sediments are deposited annually. These soils have indistinct horizons and weak structure. The kind of soil that forms in alluvium depends on the material deposited and the rate of water movement. Ordinarily, the sandier soils are nearer the stream than the finer textured soils.

The soils developed in recent eolian material, of which the Enterprise and Tivoli soils are examples, are also young and have indistinct horizons. These wind-laid materials are being deposited continuously.

Relief

Relief influences soil development through its effect on drainage and runoff. The degree of profile development depends mainly on the average amount of moisture in the soil, if other factors are equal. Nearly level soils absorb more moisture and ordinarily have better developed profiles than steeper soils. Furthermore, many of the steeper soils erode almost as fast as they form.

Relief also affects the kind and amount of vegetation on a soil. Slopes facing north and east receive less direct sunlight than those facing south and west and consequently lose less moisture through evaporation. As a result, the vegetation is denser on slopes facing north and east.

Soils that are nearly level or slightly concave are likely to have a darker color than sloping soils, because they receive more moisture, produce more vegetation, and consequently contain more organic matter, which imparts a dark color.

Time

Time is required for the formation of soils from parent material. An example is the formation of Tillman soils from the shales of Permian red beds, which were laid down about 200 million years ago. The shales weathered to clays; the clays developed into soils like those of the Vernon series, and the Vernonlike soils developed into Tillman soils. This succession occurred where all of the soil-forming factors were at work and erosion did not remove the developing soil.

Soils that have been in place for a long time and have approached equilibrium with their environment are mature or old soils. These soils show marked horizon differentiation. Some soils that have been in place for only a short time have not been influenced enough by climate and living organisms to develop well-defined and genetically related horizons. The soils on bottom lands and soils formed in eolian materials are excellent examples of such soils. Soils on steep slopes ordinarily are immature, because geologic erosion resulting from relief has overcome the influence of other factors.

Classification of Soils by Higher Categories

Classification consists of an orderly grouping of defined kinds of soils into classes in a system designed to make it easier to remember soils, including their characteristics and interrelationships, and to organize and apply the results of experience and research to areas ranging in size from several acres to millions of square miles. The defined kinds of soils are placed in narrow classes for use in detailed soil surveys and for the application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories so that information can be applied to large geographic areas.

Classes of soils defined on a comparable basis and of the same rank in a classification system comprise what is called a category. A comprehensive system of soil classification, one that will be useful in dealing with the soils of a small field as well as with the soils of a continent and of areas of intermediate size, must therefore consist of a number of categories. The higher categories consist of fewer and broader classes than the lower categories.

The system of soil classification now used in the United States has six categories (*11*). Each successively higher category consists of a smaller total number of classes, and each of those classes has a broader range of characteristics. Thus, there are thousands of classes in the lowest category and three in the highest category. The intermediate categories are also intermediate in number of classes and in permissible range of characteristics. Beginning at the top, the six categories in the system of soil classification are the order, the suborder, the great soil group, the family, the series, and the type.

Four of the six categories have been widely used, and two have been used little. Two of the three highest categories, the order and great soil group, have been used widely. Similarly, the two lowest categories, the soil series and soil type, have been used widely. The categories of suborder and family have never been fully developed and are therefore little used. In soil classification and mapping, attention has been given largely to the recognition of soil types and series within counties or comparable areas and to the subsequent grouping of the series into great soil groups and orders. The two lowest categories have been used primarily for study of soils of small geographic areas, whereas the categories of the order and great soil group have been used for the study of soils of large geographic areas.

Differences in the range within individual classes in each category are indicated by the total number of classes in that category. All soils in the United States are included in the three soil orders. These same soils are placed in some three dozen great soil groups. Approximately 7,000 soil series have been recognized in the

United States. More series will be recognized as the study of soils continues. The total number of soil types is not known exactly, because records are not maintained for individual soil types as they are for individual soils series, but it would be at least twice the number of series. From comparisons of the respective numbers of orders, great soil groups, series, and types, it is immediately obvious that the range permitted in the properties of soils within one class in a category of high rank is broad, whereas the range within an individual class in a category of low rank is relatively narrow.

The highest category in the present system of soil classification consists of three classes, known as the zonal, intrazonal, and azonal orders. The *zonal order* consists of soils with evident genetically related horizons that reflect the dominant influence of climate and living organisms in their formation. The *intrazonal order* consists of soils with evident, genetically related horizons that reflect the dominant influence of one or more local factors of parent material or topography over the effects of climate and living organisms. The *azonal order* consists of soils that lack distinct, genetically related horizons because of one or more of the following: youth of parent material, resistance of parent material to change, or steep topography.

Soils of all three orders can usually be found within a single county, as is true in Foard County. Soils of two or all three orders may occur in a single field.

Primarily, the order indicates something about important factors of soil formation and something about degree of horizonation. But the range in properties is wide within any one order. Consequently, the total number of statements that are valid for all soils within an order is limited.

The great soil group is the next lower category that has been used widely in this country. This indicates a number of relationships in soil genesis and also something about fertility, suitability for crops or trees, and the like.

Each great soil group consists of a large number of soil series that have many internal features in common. All members of a group have the same number and kind of definitive horizons in their profiles. These horizons need not be expressed to the same degree, nor do they need to be of the same thickness. Specific horizons must be recognizable, however, in every profile of a soil series representing a given great soil group.

Great soil groups in the azonal order are defined in part on the basis of the nature of the profile and in part on the basis of history or origin of the soil. None of the soils in this order has distinct horizonation. Consequently, all of them still strongly resemble the materials from which they are forming.

The classification of soil series in Foard County into great soil groups is shown in the following tabulation.

Order and great soil group	*Series*
Zonal—	
Reddish Brown	Springer.
Chestnut	Abilene, Altus, Hollister, Tipton.
Reddish Chestnut	Cobb, La Casa, Miles, Tillman, Wichita.

Order and great soil group	*Series*
Intrazonal—	
Calcisol	Acme, Weymouth.
Grumusol	Randall.
Azonal—	
Alluvial	Miller, Spur, Yahola.
Lithosol	Cottonwood, Ector, Quinlan, Vernon.
Regosol	Enterprise, Tivoli.

Zonal order

The zonal soils in Foard County are classified into three great soil groups: Reddish Brown soils, Chestnut soils, and Reddish Chestnut soils.

REDDISH BROWN SOILS

The Reddish Brown group consists of soils that develop under shrub and bunchgrass vegetation in a warm-temperate climate characterized by hot summers. The surface layer ordinarily is reddish brown to red and of mellow consistence. The upper part of the subsoil is red or reddish brown. These soils are relatively low in natural fertility in this county.

CHESTNUT SOILS

The Chestnut group consists of soils that have a dark-brown or dark grayish-brown surface layer grading to a light-gray or white, calcareous horizon at a depth of 2 to 4 feet. These soils developed in a warm-temperate, subhumid climate. They are high in natural fertility but are not highly productive because of the lack of rainfall and high rate of evaporation.

REDDISH CHESTNUT SOILS

The Reddish Chestnut group consists of soils that develop under grass in a warm-temperate, subhumid climate. The surface layer ordinarily is dark reddish brown and friable. The subsoil is heavier and tougher than the surface layer. It is reddish brown to red in the upper part and highly calcareous in the lower part. These soils are relatively high in natural fertility but are not highly productive because of the lack of rainfall and high rate of evaporation.

Intrazonal order

The intrazonal soils in Foard County are classified into two great soil groups: Calcisols and Grumusols.

CALCISOLS

The Calcisol group (*4*) consists of soils that develop where leaching is limited, mainly under a sparse stand of shrubs and short grasses. These soils have a wide geographic range that includes arid, semiarid, and subhumid climates. The surface layer is reddish brown to grayish brown and friable. The subsoil is friable and highly calcareous; it contains as much as 80 percent calcium carbonate. Calcisols are droughty and are low in fertility because they are shallow.

GRUMUSOLS

The Grumusol group (*6*) consists of soils that have a profile that is rather high in clay and relatively uniform in texture. Soils of this group are marked by signs of local movement resulting from shrinking and swelling as

they become dry and then wet. These soils form under widely varying climatic conditions, generally where wet and dry seasons alternate. The surface layer is calcareous and has granular structure. The subsoil is calcareous and has blocky structure. The Grumusols in this county have a dark-colored surface layer.

Azonal order

The azonal soils in Foard County are classified into three great soil groups: Alluvial soils, Lithosols, and Regosols (*10*).

ALLUVIAL SOILS

The soils in the Alluvial group consist of transported and relatively recently deposited material. They are characterized by little or no modification of the original material by soil-forming processes. Climatic conditions, drainage, and vegetation vary widely. Many Alluvial soils are highly productive, but some areas are subject to flooding, have poor drainage, contain salts, or are otherwise not suitable for cultivation.

LITHOSOLS

The soils in the Lithosol group lack clearly expressed soil morphology and consist of a freshly and imperfectly weathered mass of rock fragments. These soils differ, depending mainly on the nature of the underlying rock. Ordinarily they are steep, and in many areas of Foard County they are calcareous.

REGOSOLS

The soils in the Regosol group lack definite genetic horizons. They develop from deep unconsolidated or soft rocky deposits. These soils differ, depending on the nature of the underlying material.

Detailed Descriptions of Soil Profiles

This part of the report gives general information about the classification of the soils and their location in the county. It describes a profile of a typical soil of each series and discusses the range in characteristics of soils of each series in Foard County. The descriptions are based on information obtained by examination of the soils in the field.

ABILENE SERIES (Chestnut group).—The Abilene series consists of deep, well-drained, brown to very dark grayish-brown soils on the uplands. The parent materials were unconsolidated, loamy, calcareous, water-laid deposits of the Quaternary or Tertiary period. The native vegetation was short and mid grasses.

The Abilene soils are similar to the Hollister soils in color but are less clayey and more friable in the B horizon. They are somewhat like the Wichita soils but are darker colored in the surface layer and subsoil. They are darker colored in the surface layer and lighter colored and less clayey in the subsoil than the Tillman soils, which formed in Permian clays.

A representative area of Abilene clay loam is reached by going 4 miles west from Thalia on U.S. Highway 70, then 0.25 mile north on a rural road and 200 feet west into a cultivated field. Typical profile:

Ap—0 to 6 inches, dark-brown (7.5YR 4/2) clay loam; dark brown (7.5YR 3/2) when moist; weak to moderate, fine, granular structure; slightly hard when dry, friable when moist; noncalcareous; pH 7.0; a little waterworn gravel scattered over surface; abrupt boundary.

B1—6 to 12 inches, very dark grayish-brown (10YR 3/2) silty clay loam; very dark brown (10YR 2/2) when moist; moderate, fine, subangular blocky and granular structure; hard when dry, friable when moist; noncalcareous; pH 7.2; many very fine pores; common worm casts; clear boundary.

B2t—12 to 24 inches, dark grayish-brown (10YR 4/2) heavy silty clay loam or light clay; very dark grayish brown (10YR 3/2) when moist; moderate, medium, blocky structure; very hard when dry, firm when moist; noncalcareous; pH 7.2; common very fine pores; few worm casts; gradual boundary.

Bca—24 to 56 inches, dark grayish-brown (10YR 4/2) heavy silty clay loam; very dark grayish brown (10YR 3/2) when moist; moderate, medium, blocky and subangular blocky structure; very hard when dry, firm when moist; strongly calcareous, pH 7.6; common, hard and soft, medium concretions of calcium carbonate; common very fine pores; gradual boundary.

Cca—56 to 84 inches +, reddish-yellow (5YR 6/6) clay loam; yellowish red (5YR 5/6) when moist; firm when moist; very strongly calcareous; pH 8.0; many soft, coarse lumps and much soft, segregated calcium carbonate.

The A horizon ranges from 6 to 10 inches in thickness. It includes weakly calcareous, reddish-brown spots a few feet in diameter. A distinct, friable B1 horizon, 5 to 10 inches thick, is characteristic of this soil. The B2 horizon is 10 to 18 inches thick. Its structure is moderate, medium, subangular blocky, blocky, or irregular blocky. When dry, the A, B1, and B2t horizons range from brown to very dark grayish brown (7.5YR to 10YR hue). Depth to the Bca horizon varies between 20 and 36 inches. The concretions of calcium carbonate make up from 3 to 6 percent of the soil mass. Depth to the Cca horizon varies between 40 and 72 inches. In this horizon the content of calcium carbonate ranges from about 10 to 40 percent.

ACME SERIES (Calcisol group).—The Acme series consists of gently sloping, well-drained, dark-colored, shallow soils on the uplands. These soils formed in beds of whitish, impure gypsum under a cover of short and mid grasses. They occur in the northwestern and southwestern parts of the county.

The Acme soils are deeper than the Cottonwood soils.

A representative area of Acme clay loam is reached by going 3 miles south from Crowell on Texas Highway 283, then 8 miles west on Farm Road 2003 and 1 mile west on the ranch road. Typical profile:

A1—0 to 6 inches, dark grayish-brown (10YR 4/2) clay loam; very dark grayish brown (10YR 3/2) when moist; weak, fine, subangular blocky structure; very hard when dry, friable when moist; weakly calcareous; many fine pores; common root hairs; clear boundary.

AC—6 to 18 inches, dark-brown (10YR 4/3) clay loam; dark brown (10YR 3/3) when moist; weak to moderate, medium, subangular blocky structure; very hard when dry, friable when moist; strongly calcareous; many very fine and fine pores; clear boundary.

C—18 to 40 inches +, white (10YR 8/2) weathered gypsum; light gray (10YR 7/2) when moist; strongly calcareous.

The A horizon ranges from brown to dark grayish brown in color and from 6 to 8 inches in thickness. The AC horizon ranges from brown to dark grayish brown in color; from 6 to 16 inches in thickness; and from weak, coarse, prismatic to moderate, medium, subangular blocky in structure. The depth to the C horizon ranges from 12 to 22 inches.

ALTUS SERIES (Chestnut group).—The Altus series consists of deep, brown, moderately coarse textured soils on the uplands. These soils formed in moderately sandy earths consisting of outwash or ancient alluvium, under a cover of mid grasses.

The Altus soils have a darker colored surface layer and subsoil than the closely associated Miles soils. They have a sandier surface layer than the Tipton soils, and more sharply defined horizons.

A representative area of Altus fine sandy loam is reached by going 1.5 miles east from Thalia on U.S. Highway 70, then 0.5 mile north and 50 feet west into a cultivated field. Typical profile:

Ap—0 to 8 inches, brown (10YR 5/3) fine sandy loam; dark brown (10YR 4/3) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; noncalcareous; pH 7.0; abrupt boundary.

B1—8 to 20 inches, dark grayish-brown (10YR 4/2) light sandy clay loam; very dark grayish brown (10YR 3/2) when moist; weak, fine and medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; pH 7.2; many very fine and few fine pores; clear boundary.

B2t—20 to 27 inches, very dark grayish-brown (10YR 3/2) sandy clay loam; very dark brown (10YR 2/2) when moist; moderate, fine, subangular blocky structure; hard when dry, firm when moist; weakly calcareous; pH 7.2; many very fine pores; gradual boundary.

Bca—27 to 48 inches, grayish-brown (2.5Y 5/2) heavy clay loam; dark grayish brown (2.5Y 4/2) when moist; moderate, fine, subangular blocky structure; hard when dry, firm when moist; strongly calcareous; pH 7.4; common, hard, very fine and fine concretions of calcium carbonate; gradual boundary.

Cca—48 to 65 inches +, light brownish-gray (2.5Y 6/2) heavy clay loam; grayish brown (2.5Y 5/2) when moist; hard when dry, firm when moist; strongly calcareous; pH 8.0; many, hard and soft, fine to coarse concretions of calcium carbonate.

The A horizon ranges from brown to dark grayish brown (7.5YR to 10YR hue) in color and from 6 to 8 inches in thickness. In some areas it is calcareous at the surface. In a few areas the texture of the surface layer is silt loam. The B horizon ranges from about 25 to 50 inches in thickness and is light sandy clay loam or clay loam in texture. The depth to calcium carbonate varies between 24 and 32 inches. In some places calcium carbonate has not accumulated in the profile.

COBB SERIES (Reddish Chestnut group).—The Cobb series consists of well-drained, reddish-brown, shallow to moderately deep soils on the uplands. The parent material was derived from sandstone. The native vegetation was mid grasses. These soils occur along a ridge that extends from northeast to southwest in the north-central part of the county.

The Cobb soils are shallower and redder than the Miles soils, which have different parent material. They are less clayey in the subsoil than the Wichita soils.

A representative area of Cobb fine sandy loam is reached by going 1.9 miles west from junction of U.S. Highway 70 and Texas Highway 283 on U.S. Highway 70, then 0.3 mile north and 0.2 mile west into a cultivated field. Typical profile:

Ap—0 to 6 inches, reddish-brown (5YR 5/4) fine sandy loam; reddish brown (5YR 4/4) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; noncalcareous; pH 7.0; abrupt boundary.

B1—6 to 10 inches, reddish-brown (2.5YR 4/4) light sandy clay loam; dark reddish brown (2.5YR 3/4) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist; noncalcareous; pH 7.0; many very fine and common fine pores; common worm casts; clear boundary.

B2t—10 to 34 inches, red (2.5YR 4/6) sandy clay loam; dark red (2.5YR 3/6) when moist; moderate, fine and medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; pH 7.0; many very fine and few fine pores; few worm casts; gradual boundary.

C—34 to 40 inches +, red (2.5YR 4/6), soft sandstone; partially weathered; noncalcareous.

In most places the A horizon is reddish brown. It is from 4 to 8 inches thick. In the shallow variant, the B horizon is about 7 inches thick, but in the moderately deep soil, it is about 28 inches thick. This horizon is either light sandy clay loam or heavy sandy clay loam. In some places a weakly defined, indistinct zone of lime accumulation occurs. The parent material is 10 to 50 inches below the surface.

COTTONWOOD SERIES (Lithosol group).—The Cottonwood series consists of dark-colored, very shallow, strongly calcareous soils. These soils are forming mainly in outcrops of gypsum, which is likely of the Blaine formation of the Permian system. In this county the Cottonwood soils are mapped as complexes with the Acme, Ector, and Vernon soils.

The Cottonwood soils have a darker colored surface layer than the Vernon soils, which have different parent material. Their surface layer is somewhat like that of the Ector soils, which also have different parent material.

A representative area of Cottonwood clay loam is reached by going 3 miles south of Crowell courthouse on Texas Highway 283, then 8 miles west on Farm Road 2003, and 1 mile west on a ranch trail. Typical profile:

A1—0 to 4 inches, grayish-brown (10YR 5/2) clay loam; very dark grayish brown (10YR 3/2) when moist; weak, fine, subangular blocky structure; slightly hard when dry, friable when moist; weakly calcareous; mildly alkaline; clear boundary.

C—4 to 12 inches +, white (N 8/0), very fine sandy material composed largely of gypsum.

The soil material is 2 to 10 inches thick over the gypsum. It ranges from weakly to strongly calcareous and from brown to dark grayish brown.

ECTOR SERIES (Lithosol group).—The Ector series consists of very shallow, dark-colored soils on the uplands. These soils are forming in place over dolomitic limestone of the Permian system. They are mainly on the gently to strongly sloping ridges in the western part of the county.

The Ector soils are somewhat like the Cottonwood soils but have different parent material. They have a darker colored surface layer than the Vernon soils, which also have different parent material.

A representative area of Ector soils is reached by going 10 miles northwest of Crowell courthouse on U.S. Highway 70, then 7 miles southwest on Farm Road 654, and 2 miles south on a ranch road. Typical profile:

A1—0 to 5 inches dark grayish-brown (10YR 4/2) loam; very dark grayish brown (10YR 3/2) when moist; weak, fine, subangular blocky structure; hard when dry, very friable when moist; strongly calcareous; many fine to coarse concretions of limestone; clear boundary.

R—5 to 12 inches +, gray (N 5/0), indurated, semifractured, dolomitic limestone; strongly calcareous.

The soil material is from 1 to 8 inches thick over the limestone. It ranges from brown to dark grayish brown (10YR) in color and from loam to clay loam or stony loam

in texture. In places concretions or fragments of limestone make up 30 percent of the soil mass.

ENTERPRISE SERIES (Regosol group).—The Enterprise series consists of deep, well-drained, brown to reddish-brown soils on the uplands. The parent materials were medium-textured eolian deposits. The native vegetation was mid and tall grasses. These soils occupy low terraces near the Pease River in the northeastern part of the county Two types were mapped in this county: fine sandy loam and very fine sandy loam.

The Enterprise soils have a lighter colored surface layer and a less clayey subsoil than the Tipton soils and are finer textured throughout than the Tivoli soils.

A representative area of Enterprise very fine sandy loam is reached by going 1.7 miles northeast of Margaret on Farm Road 98, then 0.8 mile north, 0.5 mile east, and 0.65 mile north into a cultivated field. Typical profile:

Ap—0 to 8 inches, reddish-brown (5YR 5/4) very fine sandy loam; dark reddish brown (5YR 3/4) when moist; weak, granular structure; slightly hard when dry, very friable when moist; noncalcareous; mildly alkaline; abrupt boundary.

A1—8 to 18 inches, reddish-brown (5YR 5/4) very fine sandy loam; dark reddish brown (5YR 3/4) when moist; compound structure—weak, coarse, prismatic and weak, fine, granular; slightly hard when dry, very friable when moist; noncalcareous; mildly alkaline; many very fine to medium pores; many worm casts; gradual boundary.

AC—18 to 65 inches, reddish-brown (5YR 5/4) very fine sandy loam; reddish brown (5YR 4/4) when moist; compound structure—weak, coarse, prismatic and weak, fine, granular; slightly hard when dry, very friable when moist; strongly calcareous; moderately alkaline; common threads and films of calcium carbonate between and through the peds; many very fine pores; few worm casts; gradual boundary.

C—65 to 75 inches +, yellowish-red (5YR 5/6) very fine sandy loam; yellowish red (5YR 4/6) when moist; very strongly calcareous; common threads and films of calcium carbonate between and through peds.

The A horizon ranges from 16 to 30 inches in thickness and from reddish brown to brown in color. It is either very fine sandy loam or fine sandy loam in texture. In some areas it is weakly calcareous. Depth to the C horizon, where this horizon can be identified, ranges from 30 to 70 inches. Because of wind erosion, there are areas of the sandy loam type that have a winnowed surface layer that is sandier than it was in the past.

HOLLISTER SERIES (Chestnut group).—The Hollister series consists of deep, dark-colored, level and nearly level soils on smooth uplands. These soils formed in Permian shales and clays under a cover of short grasses. They are mostly in the southern part of the county.

The Hollister soils have a more clayey subsoil than the Abilene soils. They have a darker colored surface layer and subsoil than the Tillman soils and a darker colored and more clayey subsoil than the La Casa soils.

A representative area of Hollister clay loam is reached by going 3.6 miles south from junction of Texas Highway 283 and Farm Road 1594 on Texas Highway 283, then 0.2 mile east and 50 feet east into a cultivated field. Typical profile:

Ap—0 to 6 inches, brown (10YR 5/3) clay loam; dark brown (10YR 3/3) when moist; weak, granular structure; slightly hard when dry, very friable when moist; noncalcareous; mildly alkaline; abrupt boundary.

B1—6 to 11 inches, very dark grayish-brown (10YR 3/2) heavy clay loam; very dark brown (10YR 2/2) when moist; weak, fine and medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; mildly alkaline; few, faint, patchy films of clay; many very fine pores; few worm casts; clear boundary.

B21t—11 to 20 inches, very dark grayish-brown (10YR 3/2) clay; very dark brown (10YR 2/2) when moist; strong, medium, blocky and irregular blocky structure; extremely hard when dry, very firm when moist; noncalcareous; mildly alkaline; distinct, patchy films of clay; few very fine pores; gradual boundary.

B22t—20 to 48 inches, dark-brown (7.5YR 4/3) clay; dark brown (7.5YR 3/3) when moist; strong, medium, blocky and irregular blocky structure; extremely hard when dry, very firm when moist; weakly calcareous; mildly to moderately alkaline; few very fine and fine concretions of calcium carbonate; gradual boundary.

Bca—48 to 58 inches, brown (7.5YR 5/3) clay; dark brown (7.5YR 4/3) when moist; extremely hard when dry; strongly calcareous; moderately alkaline; common, very fine and fine, hard concretions of calcium carbonate; gradual boundary.

Cca—58 to 84 inches, reddish-yellow (5YR 6/6) clay; yellowish red (5YR 5/6) when moist; strongly calcareous; moderately alkaline; many, hard and soft, fine concretions of calcium carbonate; gradual boundary.

C—84 to 90 inches +, red (2.5YR 4/6), partially weathered, calcareous red-bed clay.

The A horizon ranges from brown to very dark grayish brown (7.5 YR to 10YR) in color and from 4 to 7 inches in thickness. A few small, circular spots are calcareous. A friable, distinct B1 horizon, 3 to 10 inches thick, is characteristic of this soil. The color of the B horizon ranges from brown to very dark grayish brown (7.5YR to 10YR), and the thickness from 18 to 64 inches. The texture ranges from clay loam in the B1 horizon to clay in the B2. The reaction is mildly or moderately alkaline. Depth to the Cca horizon varies between 38 and 64 inches.

LA CASA SERIES (Reddish Chestnut group).—The La Casa series consists of calcareous, gently sloping, well-drained, moderately deep soils on the uplands. These soils developed in moderately clayey, highly calcareous material of the Permian red beds. They occur mostly in the western part of the county. They have been mapped both separately and as a complex with the Ector soils.

The La Casa soils are deeper and darker colored than the Vernon and Weymouth soils. They have a redder, less clayey, and more friable subsoil than the Hollister and Abilene soils and a less clayey and more friable subsoil than the Tillman soils.

A representative area of La Casa clay loam is reached by going 9 miles northwest from the Crowell courthouse on U.S. Highway 70, 2.5 miles northwest on Farm Road 2566, and 50 feet south into a pasture. Typical profile:

A1—0 to 6 inches, brown (7.5YR 5/4) clay loam; dark brown (7.5YR 4/4) when moist; weak, fine, subangular blocky structure; slightly hard when dry, friable when moist; strongly calcareous; pH 7.5; many very fine and common fine pores; clear boundary.

B1—6 to 10 inches, brown (7.5YR 5/4) silty clay loam; dark brown (7.5YR 4/4) when moist; moderate, medium, subangular blocky structure; hard when dry, friable when moist; strongly calcareous; pH 7.5; few, hard, fine concretions of calcium carbonate; many very fine pores; gradual boundary.

B2—10 to 36 inches, reddish-brown (5YR 5/4) silty clay loam; reddish brown (5YR 4/4) when moist; moderate, medium, subangular blocky structure; hard when dry, friable when moist; strongly calcareous, pH 7.5; many, hard, fine concretions of calcium carbonate; many very fine pores; gradual boundary.

Cca—36 to 72 inches +, reddish-yellow (7.5YR 7/6) light clay loam; reddish yellow (7.5YR 6/6) when moist; hard when dry, friable when moist; very strongly calcareous; pH 8.0; many, hard and soft, fine to coarse concretions of calcium carbonate.

The A1 horizon ranges from brown to reddish brown (5YR to 10YR) in color, from 4 to 6 inches in thickness, and from weakly to strongly calcareous. The B horizon ranges from 16 to 40 inches in thickness and from brown to reddish brown in color. In some places there is a Bca horizon. Layers of calcium carbonate occur 22 to 55 inches below the surface.

MILES SERIES (Reddish Chestnut group).—The Miles series consists of well-drained, brown to reddish-brown, deep soils on the uplands. These soils formed in sandy outwash or ancient alluvium of the Quaternary period under a cover of mid and tall grasses. They occur in the northeastern part of the county. There are two types: loamy fine sand and fine sandy loam.

The Miles soils have a finer textured subsoil than the Springer soils. They are deeper than the Cobb soils, which have different parent material. They have a sandier surface layer and a less clayey, more friable subsoil than the Wichita soils and a lighter colored surface layer and subsoil than the Altus soils.

A representative area of Miles fine sandy loam is reached by going 0.3 mile northeast from Margaret on Farm Road 98, then 1.8 miles north on rural road and 150 feet east into a cultivated field. Typical profile:

Ap—0 to 8 inches, brown (7.5YR 5/4) fine sandy loam; dark brown (7.5YR 3/4) when moist; weak, granular structure; slightly hard when dry, very friable when moist; noncalcareous; pH 7.0; abrupt boundary.

B1—8 to 13 inches, reddish-brown (5YR 4/3) heavy fine sandy loam; dark reddish brown (5YR 3/3) when moist; compound structure—weak very coarse prismatic and weak medium subangular blocky; hard when dry, very friable when moist; noncalcareous; pH 7.0; many very fine to fine pores, many worm casts; gradual boundary.

B2t—13 to 30 inches, reddish-brown (5YR 4/4) sandy clay loam; dark reddish brown (5YR 3/4) when moist; compound structure—weak very coarse prismatic and weak medium subangular blocky; very hard when dry, friable when moist; noncalcareous; pH 7.2; many very fine to fine pores; common worm casts; gradual boundary.

B3—30 to 52 inches, reddish-brown (5YR 4/5) light sandy clay loam; dark reddish brown (5YR 3/5) when moist; compound structure—very coarse prismatic and weak medium subangular blocky; very hard when dry, friable when moist; noncalcareous; pH 7.4; gradual boundary.

C—52 to 65 inches +, yellowish-red (5YR 5/8) fine sandy loam; yellowish red (5YR 4/8) when moist; very friable when moist; noncalcareous; pH 7.8.

In the fine sandy loam type, the A horizon ranges from 4 to 12 inches in thickness and from reddish brown to brown (5YR to 7.5 YR) in color. In the loamy fine sand type, the A horizon ranges to about 20 inches in thickness, and from light brown to brown (7.5YR to 10YR) in color. Included are small areas that have a surface layer as much as 26 inches thick. The B horizon ranges from heavy fine sandy loam to heavy sandy clay loam in texture, from 28 to 50 inches in thickness, and from red to reddish brown (2.5YR to 5YR) in color. Depth to the C horizon, where this horizon can be identified, varies between 28 and 74 inches. In most places the loamy fine sand type is underlain at a depth of 35 inches or more by a dark-colored, buried soil. About 50 percent of the areas of fine sandy loam contain a zone of lime.

MILLER SERIES (Alluvial group).—The Miller series consists of reddish-brown, calcareous soils on the bottom lands. They are developing in clayey, recent alluvial sediments, mostly of red-bed origin. They occur along most of the larger creeks in the southeastern part of the county.

The Miller soils have a more clayey and less friable subsoil than the Spur soils.

A representative area of Miller clay is reached by going 0.7 mile north of the North Wichita River bridge on Texas Highway 283, and 50 feet west into a pasture. Typical profile:

A1—0 to 12 inches, reddish-brown (5YR 4/3) clay; dark reddish brown (5YR 3/3) when moist; compound structure—moderate medium blocky and weak fine irregular blocky; very hard when dry, very firm when moist; weakly calcareous; neutral; abrupt boundary.

AC—12 to 40 inches, reddish-brown (2.5YR 5/4) clay; reddish brown (2.5YR 4/4) when moist; moderate, fine, irregular blocky structure; very hard when dry, very firm when moist; strongly calcareous; mildly alkaline; few very fine pores; gradual boundary.

C—40 to 45 inches +, red (2.5YR 4/6) clay; dark red (2.5YR 3/6) when moist; moderate, medium, blocky structure; extremely hard when dry, very firm when moist; strongly calcareous; mildly alkaline; few very fine spots of calcium carbonate; few very fine pores.

The surface layer is reddish brown (2.5YR to 5YR). It ranges from clay loam to clay in texture and from 10 to 18 inches in thickness. In some places the subsoil is stratified with thin lenses of light clay, silty clay loam, and clay loam. In a few places the surface layer is noncalcareous.

QUINLAN SERIES (Lithosol group).—The Quinlan series consists of friable, shallow, reddish-brown, moderately sloping soils on the uplands. These soils are developing in place over noncalcareous Permian sandstone. They occur on a high ridge in the north-central part of the county.

In this county the Quinlan soils are mapped as a complex with the Cobb soils. They are less clayey in the subsoil than the Cobb soils and are sandier throughout than the Vernon and Weymouth soils.

A representative area of Quinlan fine sandy loam is reached by going 1.9 miles west from Crowell courthouse on U.S. Highway 70, then 1 mile north, 0.25 mile west, and 150 feet north into a cultivated field. Typical profile:

Ap—0 to 6 inches, red (2.5YR 4/6) fine sandy loam; dark red (2.5YR 3/6) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; noncalcareous; pH 7.0; abrupt boundary.

AC—6 to 13 inches, reddish-brown (2.5YR 4/4) fine sandy loam; dark reddish brown (2.5YR 3/4) when moist; weak, medium, subangular blocky structure; slightly hard when dry, very friable when moist; noncalcareous; pH 7.0; many very fine to fine pores; thin lenses of sandstone on lower part; clear boundary.

C—13 to 18 inches +, red (10YR 4/5), soft to semi-indurated, neutral, Permian sandstone.

The soil material is 6 to 17 inches thick over the sandstone. The surface layer ranges from red to reddish brown (2.5YR to 5YR) in color. In most areas the parent material is red to reddish brown, but in some areas it is olive gray.

RANDALL SERIES (Grumusol group).—The Randall series consists of deep, poorly drained, dark-gray, nearly level soils on the uplands. These soils developed in calcareous clays, mainly old alluvium or outwash of the Quaternary period. They occur in weakly concave depressions.

The Randall soils have a darker colored, more grayish, less friable, more clayey surface layer and subsoil than

the Abilene soils. They have a more grayish, less friable, more clayey surface layer than the Hollister soils.

A representative area of Randall clay is reached by going 4.7 miles west from Thalia on U.S. Highway 70, and 50 feet north in a pasture. Typical profile:

A1—0 to 6 inches, dark-gray (2.5Y 4/1) clay; very dark gray (2.5Y 3/1) when moist; weak, fine, subangular blocky structure; very hard when dry, firm when moist; weakly calcareous; pH 7.5; many very fine roots; clear boundary.

AC—6 to 60 inches +, gray (2.5Y 5/1) clay; dark gray (2.5Y 4/1) when moist; moderate, medium, blocky structure; very hard when dry, very firm when moist; strongly calcareous; pH 8.0; many, hard, fine concretions of calcium carbonate; few very fine pores.

The A horizon ranges from gray to very dark gray (2.5Y) in color. In some places it is noncalcareous. The AC horizon is gray or dark gray.

SPRINGER SERIES (Reddish Brown group). The Springer series consists of deep, well-drained, brown to reddish-brown soils. The parent material was sandy outwash or ancient alluvium of the Quaternary period. These soils occur only in the northern and eastern parts of the county.

The Springer soils have a more friable and less clayey subsoil than the Miles soils. They are less sandy throughout than the Tivoli soils.

A representative area of Springer loamy fine sand is reached by going 2.5 miles east from Thalia on U.S. Highway 70, and 0.6 mile north into a cultivated field. Typical profile:

Ap—0 to 16 inches, brown (7.5YR 5/4) loamy fine sand; dark brown (7.5YR 4/4) when moist; structureless (single grain); loose when dry and when moist; noncalcareous; pH 6.5; abrupt boundary.

B1—16 to 22 inches, reddish-brown (5YR 5/4) fine sandy loam; reddish brown (5YR 4/4) when moist; compound structure—weak, coarse, prismatic and weak, fine, subangular blocky; hard when dry, very friable when moist; noncalcareous; pH 7.0; many very fine and fine pores; common worm casts; clear boundary.

B2t—22 to 36 inches, reddish-brown (5YR 5/4) heavy fine sandy loam; reddish brown (5YR 4/4) when moist; compound structure—weak coarse prismatic and weak fine subangular blocky; hard when dry, very friable when moist; noncalcareous; pH 7.0; many very fine and fine pores; few worm casts; gradual boundary.

B2tb—36 to 48 inches +, dark-brown (10YR 4/3) heavy sandy clay loam; dark brown (10YR 3/3) when moist; moderate, medium, subangular blocky structure; very hard when dry, firm when moist; noncalcareous.

The A horizon ranges from light brown to light reddish brown (5YR to 10YR) in color and from 12 to 26 inches in thickness. The B horizon is reddish brown (2.5YR to 5YR). It ranges from 18 to 55 inches in thickness and from light to heavy fine sandy loam in texture. In some places this soil lacks a B1 horizon, and in other places it has a B3 horizon. Ordinarily, a buried soil occurs 30 to 48 inches below the surface. The C horizon, where it was observed, is yellowish-red loamy fine sand.

SPUR SERIES (Alluvial group).—The Spur series consists of deep, well-drained, reddish-brown to brown soils on the bottom lands. These soils are developing in recent loamy alluvial sediments under mid and tall grasses. They are widely distributed and occur along most of the small creeks and rivers. Two types were mapped in this county: clay loam and silt loam.

The Spur soils have a more friable, less clayey subsoil than the Miller soils, and a less sandy subsoil than the Yahola soils.

A representative area of Spur clay loam is reached by going 4 miles west from Foard City on Farm Road 263; then, on rural road, 1 mile north, 0.5 mile west, 3 miles southwest, 0.5 mile south, and 0.4 mile east; then 100 feet north into cultivated field. Typical profile:

Ap—0 to 6 inches, dark-brown (7.5YR 4/3) clay loam; dark brown (7.5YR 3/3) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; strongly calcareous; neutral; abrupt boundary.

A1—6 to 20 inches, brown (7.5YR 5/4) silty clay loam; dark brown (7.5YR 4/4) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist; strongly calcareous; mildly alkaline; many very fine and common fine pores; common worm casts; gradual boundary.

AC—20 to 60 inches +, brown (7.5YR 5/4) light silty clay loam; dark brown (7.5YR 4/4) when moist; weak, fine, subangular blocky structure; hard when dry, very friable when moist; strongly calcareous; mildly alkaline; many very fine pores.

The A horizon ranges from reddish brown to dark brown (5YR to 7.5YR) in color, from clay loam to silt loam in texture, and from 10 to 24 inches in thickness. In some places it is noncalcareous. In places the AC horizon is stratified with lenses of clay loam, silt loam, and very fine sandy loam.

TILLMAN SERIES (Reddish Chestnut group).—The Tillman series consists of deep, reddish-brown to brown soils on the uplands. These soils developed in Permian shales and clays under a cover of short grasses. They are widely distributed throughout the southern and western parts of the county.

The Tillman soils have a redder surface layer and subsoil than the Hollister soils. They are lighter colored in the surface layer and more clayey in the subsoil than the La Casa soils and have a thicker solum than the Vernon soils.

A representative area of Tillman clay loam is reached by going 0.5 mile east from Crowell courthouse on U.S. Highway 70, then 2.2 miles south on the rural road, and 100 feet west into a cultivated field. Typical profile:

Ap—0 to 5 inches, reddish-brown (5YR 4/4) clay loam; dark reddish brown (5YR 3/4) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist; noncalcareous; neutral; abrupt boundary.

B1—5 to 11 inches, reddish-brown (5YR 4/3) light clay; dark reddish brown (5YR 3/3) when moist; weak, medium, subangular blocky structure; very hard when dry, firm when moist; noncalcareous; neutral; common very fine pores; faint, patchy clay films; clear boundary.

B21t—11 to 20 inches, reddish-brown (2.5YR 4/3) clay; dark reddish brown (2.5YR 3/3) when moist; strong, medium, blocky and irregular blocky structure; extremely hard when dry, very firm when moist; weakly calcareous; neutral to mildly alkaline; few very fine pores; distinct, patchy clay films; gradual boundary.

B22t—20 to 34 inches, reddish-brown (2.5YR 4/4) clay; dark reddish brown (2.5YR 3/4) when moist; strong, medium, blocky and irregular blocky structure; extremely hard when dry, very firm when moist; weakly calcareous; mildly alkaline; few, hard, segregated concretions of calcium carbonate; gradual boundary.

Bca—34 to 39 inches, reddish-brown (2.5YR 4/4) clay; dark reddish brown (2.5YR 3/4) when moist; moderate, fine, blocky and irregular blocky structure; very

hard when dry, firm when moist; strongly calcareous; mildly alkaline; common, very fine to medium, segregated concretions of calcium carbonate; few very fine pores; gradual boundary.

Cca—39 to 46 inches, reddish-brown (2.5YR 5/4) clay; reddish brown (2.5YR 4/4) when moist; firm when moist; strongly calcareous; moderately alkaline; many, very fine to medium, hard concretions of calcium carbonate, which make up about 20 percent of the soil mass; gradual boundary.

C—46 to 62 inches +, red (2.5YR 4/6), partially weathered, calcareous red-bed clay.

The A horizon ranges from reddish brown to brown (5YR to 7.5YR) in color and from 3 to 7 inches in thickness. In some places it is weakly calcareous. The B horizon is reddish brown (2.5YR to 5YR). It ranges from 24 to 45 inches in thickness and from light clay to clay in texture. The reaction is neutral to moderately alkaline. The structure is weak, subangular blocky in the B1 horizon and strong blocky or irregular blocky in the B21t and B22t horizons. The depth to the Cca horizon ranges from 28 to 50 inches. The depth to the C horizon generally is about 60 inches.

TIPTON SERIES (Chestnut group).—The Tipton series consists of deep, friable, well-drained, dark-colored soils on the uplands. These soils formed in moderately fine textured outwash or ancient alluvium under a cover of mid grasses. They occur only in the northern part of the county, along the low terraces of the Pease River.

The Tipton soils are darker colored and less sandy than the Miles soils. They have a less clayey subsoil than the Altus soils and are darker colored and more clayey than the Enterprise soils.

A representative area of Tipton silt loam is reached by going 2.7 miles west of Rayland on Farm Road 98, and 0.1 mile north into a cultivated field. Typical profile:

Ap–0 to 8 inches, dark-brown (7.5YR 4/3) silt loam; dark brown (7.5YR 3/3) when moist; weak, granular structure; slightly hard when dry, very friable when moist; noncalcareous; pH 7.0; abrupt boundary.

B1–8 to 22 inches, dark grayish-brown (10YR 4/2) loam; very dark grayish brown (10YR 3/2) when moist; weak, fine to medium, subangular blocky structure; hard when dry, very friable when moist; noncalcareous; pH 7.2; many very fine to fine pores; many worm casts; gradual boundary.

B2t–22 to 33 inches, dark-brown (7.5YR 4/2) clay loam; dark brown (7.5YR 3/2) when moist; moderate, medium, subangular blocky structure; hard when dry, friable when moist; noncalcareous; pH 7.4; many very fine and few fine pores; few worm casts; gradual boundary.

B2tb–33 to 46 inches +, dark-brown (10YR 4/3) heavy clay loam; dark brown (10YR 3/3) when moist; moderate, medium, subangular blocky structure; hard when dry, firm when moist; noncalcareous.

The A horizon ranges from brown to very dark grayish brown (7.5YR to 10YR) in color and from 5 to 10 inches in thickness. The B horizon ranges from dark brown to very dark grayish brown (7.5YR to 10YR) in color, from 14 to 34 inches in thickness, and from loam to clay loam or sandy clay loam in texture. In places there is a Bca horizon. In places where this soil is not underlain by a buried soil, there is a C horizon of reddish-yellow sandy clay loam.

TIVOLI SERIES (Regosol group).—The Tivoli series consists of light-colored, well-drained sandy soils that are forming in a coarse-textured, eolian mantle. These soils occupy the dunes adjacent to the Pease River.

The Tivoli soils have a sandier surface layer and subsoil than the Springer, Miles, and Enterprise soils.

A representative area of Tivoli fine sand is reached by going 2 miles west of Rayland on Farm Road 98, and 0.8 mile north into a pasture. Typical profile:

A1–0 to 8 inches, yellowish-red (5YR 5/6) fine sand; yellowish red (5YR 4/6) when moist; structureless (single grain); loose when dry and when moist; weakly calcareous; mildly alkaline; gradual boundary.

C–8 to 70 inches +, reddish-yellow (5YR 6/6) fine sand; yellowish red (5YR 5/6) when moist; structureless (single grain); loose when dry and when moist; weakly calcareous; moderately alkaline.

The A horizon ranges from 6 to 14 inches in thickness and from light brown to yellowish red (5YR to 7.5YR) in color. In some places it is noncalcareous. The C horizon ranges from yellowish red to reddish yellow (5YR).

VERNON SERIES (Lithosol group).—The Vernon series consists of reddish calcareous, shallow and very shallow soils on the uplands. These soils are developing in clay and shale of the Permian red beds. They are widely distributed throughout the county and are mapped as complexes with the Weymouth, Cottonwood, Acme, and Ector soils and with red-bed outcrops.

The Vernon soils have a thinner, less mature profile than the Tillman soils. They are more clayey and less friable than the Weymouth soils and have less segregated calcium carbonate in the subsoil. They are more clayey in the surface layer and subsoil than the Cobb soils.

A representative area of Vernon clay loam is reached by going 1 mile east from the junction of Farm Road 263 and Texas Highway 283, then 0.2 mile south, 0.6 mile east, and 100 feet north into a pasture. Typical profile:

A1—0 to 5 inches, reddish-brown (5YR 4/4) clay loam; dark reddish brown (5YR 3/4) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist; strongly calcareous, moderately alkaline; few, hard, fine, segregated concretions of calcium carbonate; clear boundary.

AC—5 to 14 inches, reddish-brown (2.5YR 4/4) light clay; dark reddish brown (2.5YR 3/4) when moist; moderate, medium, blocky and subangular blocky structure; very hard when dry, firm when moist; strongly calcareous; moderately alkaline; few, hard, fine concretions of calcium carbonate; few fine pores; few worm casts; gradual boundary.

C—14 to 20 inches +, red (2.5YR 4/6), partially weathered, calcareous clay of the Permian red beds.

The A horizon ranges from 2 to 6 inches in thickness and from reddish brown to brown (5YR to 10YR) in color. The AC horizon ranges from reddish brown to yellowish red (2.5YR to 5YR) in color, from 4 to 15 inches in thickness, and from light clay to clay in texture. This horizon is lacking in some places. The depth to the C horizon is 5 to 20 inches.

WEYMOUTH SERIES (Calcisol group).—The Weymouth series consists of friable, shallow, brown to reddish-brown soils on the uplands. The parent material is strongly calcareous, clayey sediments, mainly of the Permian red beds. The native vegetation was short grasses. In this county, these soils are mapped as a complex with the Vernon soils.

The Weymouth soils are less clayey and more friable than the Vernon soils and contain more segregated calcium carbonate in both the subsoil and the parent material. They are lighter colored and have thinner profiles than

the La Casa soils and are less sandy throughout than the Cobb soils.

A representative area of Weymouth clay loam is reached by going 3.3 miles southwest from junction of U.S. Highway 70 and Farm Road 654, and 0.15 mile south into a pasture. Typical profile:

A1—0 to 6 inches, reddish-brown (5YR 5/4) clay loam; dark reddish brown (5YR 3/4) when moist; weak, fine, subangular blocky structure; hard when dry, very friable when moist; strongly calcareous; pH 7.5; common roots; many very fine to fine pores; clear boundary.

AC—6 to 14 inches, reddish-brown (5YR 5/4) clay loam; dark reddish brown (5YR 3/4) when moist; weak, fine to medium, subangular blocky structure; hard when dry, friable when moist; very strongly calcareous; pH 7.7; few, fine, hard, segregated concretions of calcium carbonate; few films and threads of calcium carbonate; many very fine to fine pores; common worm casts; common roots; gradual boundary.

Cca—14 to 22 inches, reddish-brown (2.5YR 4/4) clay loam; dark reddish brown (2.5YR 3/4) when moist; weak, medium, subangular blocky structure; hard when dry, very friable when moist; very strongly calcareous; pH 8.0; common, fine to medium, hard and soft, segregated concretions of calcium carbonate make up about 15 percent of the soil mass; gradual boundary.

C—22 to 26 inches +, reddish-brown (2.5YR 4/4), partially weathered, strongly calcareous clay of the Permian red beds.

The A1 horizon ranges from 3 to 7 inches in thickness and from brown to reddish brown (5YR to 7.5YR) in color. It is weakly to strongly calcareous. The AC horizon ranges from 6 to 15 inches in thickness and from clay loam to light clay in texture. In some places the Cca horizon is thin and indistinct, but in other places it is thick. The depth to the C horizon ranges from 14 to 30 inches.

WICHITA SERIES (Reddish Chestnut).—The Wichita series consists of deep, well-drained, brown to reddish-brown soils on the uplands. These soils formed in calcareous outwash from ancient alluvium, largely from the Permian red beds. Two types are mapped in this county: clay loam and loam.

The Wichita soils have a less sandy surface layer and a more clayey subsoil than the Miles soils. They are lighter colored throughout than the Abilene soils and are more clayey in both the surface layer and subsoil than the Cobb soils.

A representative area of Wichita loam is reached by going 1.5 miles north from Crowell courthouse on Texas Highway 283, and 100 feet west into a cultivated field. Typical profile:

Ap—0 to 5 inches, reddish-brown (5YR 4/3) loam; dark reddish brown (5YR 3/3) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; noncalcareous; neutral; abrupt boundary.

B1—5 to 9 inches, reddish-brown (5YR 4/3) clay loam; dark reddish brown (5YR 3/3) when moist; weak, fine, subangular blocky structure; hard when dry, friable when moist; noncalcareous; neutral; many very fine and fine pores; common worm casts; clear boundary.

B21t—9 to 14 inches, reddish-brown (5YR 4/3) heavy clay loam; dark reddish brown (5YR 3/3) when moist; moderate, fine, blocky and subangular blocky structure; very hard when dry, firm when moist; noncalcareous; neutral; common very fine pores; faint, patchy films of clay; clear boundary.

B22t—14 to 25 inches, reddish-brown (2.5YR 4/4) heavy clay loam; dark reddish brown (2.5YR 3/4) when moist; moderate, fine, blocky and subangular blocky structure; very hard when dry, firm when moist; noncalcareous; neutral to mildly alkaline; common very fine pores; faint, patchy clay films; gradual boundary.

Bca—25 to 42 inches, reddish-brown (2.5YR 4/4) heavy clay loam; dark reddish brown (2.5YR 3/4) when moist; moderate, fine, subangular blocky structure; very hard when dry; weakly calcareous; mildly alkaline; few, hard, fine to medium, segregated concretions of calcium carbonate; gradual boundary.

Cca—42 to 48 inches, reddish-brown (2.5YR 4/5) heavy clay loam; dark reddish brown (2.5YR 3/5) when moist; very hard when dry; strongly calcareous; moderately alkaline; common, hard, fine to coarse, segregated concretions of calcium carbonate; gradual boundary.

C—48 to 62 inches +, reddish-brown (2.5YR 5/5) sandy clay loam, largely reworked Permian material.

The A horizon ranges from brown to reddish brown (5YR to 7.5YR) in color and from 4 to 7 inches in thickness. The B horizon ranges from reddish brown to dark reddish brown (2.5YR to 5YR) in color, from 25 to 48 inches in thickness, and from clay loam to light clay in texture. In some places the friable B1 horizon is indistinct. In other places there is a B3 horizon. In a few places the zone of calcium carbonate is either lacking or inconspicuous. In places these soils are underlain by sandstone or by clayey red beds.

YAHOLA SERIES (Alluvial group).—The Yahola series consists of deep, well-drained, brown to yellowish-red soils on the bottom lands. They are developing in sandy alluvium along the flood plains of the Wichita and Pease Rivers.

The Yahola soils have a sandier subsoil than the Spur soils. They are lighter colored and less clayey than the Miller soils.

A representative area of Yahola very fine sandy loam is reached by going 5.6 miles west and northwest of Foard City on Farm Road 263 and on rural road 0.4 mile south, 0.4 mile west, 1.7 miles southwest, 0.55 mile east, and 0.7 mile southwest into a cultivated field. Typical profile:

Ap—0 to 6 inches, yellowish-red (5YR 5/6) very fine sandy loam; yellowish red (5YR 4/6) when moist; weak, fine granular structure; slightly hard when dry, very friable when moist; weakly calcareous; mildly alkaline; abrupt boundary.

A1—6 to 24 inches, yellowish-red (5YR 5/6) very fine sandy loam; yellowish red (5YR 4/6) when moist; compound structure—weak coarse prismatic and weak fine granular; slightly hard when dry, very friable when moist; weakly calcareous; mildly alkaline; many very fine to fine pores; common worm casts; gradual boundary.

AC—24 to 60 inches +, reddish-yellow (5YR 6/6) fine sandy loam; yellowish red (5YR 5/6) when moist; weak, fine, granular structure; slightly hard when dry, very friable when moist; strongly calcareous; moderately alkaline.

The A horizon ranges from brown to yellowish red (5YR to 7.5YR) in color and from 18 to 30 inches in thickness. In some places it is noncalcareous. In most places the AC horizon is stratified with layers of very fine sandy loam, fine sandy loam, or loamy fine sand.

Additional Facts About the County

The area around Margaret was the first part of Foard County to be settled. Most of the early settlers depended on small farms for their livelihood. The farming consisted only of growing a few vegetables and cutting some native grass for hay.

Cattle ranching began about 1878. The heavy growth of nutritious grasses and the mild climate made this part of Texas especially suitable for raising livestock. Ranchers at first depended solely on the native grasses for livestock feed.

Cultivation of crops on a large scale began about 1890. By 1910, nearly half of the acreage suitable for crops was in cultivation.

During recent years, because of more opportunities for different jobs, better transportation facilities, and more competition in agriculture, the number of small farms has gradually decreased. The number of farms in 1920 was 629. In 1959 the number had decreased to 369. There are several large ranches in the county, and about 45 percent of the acreage is rangeland. Oil is becoming an important source of income, but farming and ranching are still the major factors in the economy of the county.

Foard County is served by U.S. Highway 70 and Texas Highway 283, which give access to all other major roads in the county. The Panhandle and Santa Fe Railway provides shipping facilities for agricultural and other products. There are two high schools and three grammar schools in the county, and churches of various denominations.

Physiography

Foard County lies entirely within the Rolling Plains, a subdivision of the Central Lowland Province. It is an area of well-developed drainage and moderate relief. The topography generally can be classified as undulating or rolling, but it varies between fairly smooth plains and sharply eroded valley edges. Elevations are 1,400 to 1,700 feet and dip to the east.

The county is drained chiefly by the Pease River, which is its northern boundary, and by the Wichita River, its southern boundary. The central part of the county is drained by numerous creeks, including Beaver, Paradise, Good, Mule, Talking John, Blacks Branch, Blue Prong, and Raggedy Creeks.

Climate [4]

The climate of Foard County is transitional between the semiarid climate characteristic of northwest Texas and the more humid climate of east Texas.

Annual rainfall averages 24 inches, but the distribution is extremely erratic (table 6). The rainfall varies widely from month to month and from year to year (*5*). Most rainfall occurs as the result of thunderstorm activity, rather than from general rains, and it is a characteristic of thundershowers to be spotty geographically. Annual amounts have varied between 10.28 inches in 1956 and 39.83 inches in 1941. Periods of 30 days or more without precipitation have occurred in all months of the year except May. The greatest average monthly rainfall occurs in May because thunderstorm activity reaches its peak during this month. Slightly more than 68 percent of the annual precipitation occurs during the warmer 6 months of the year (May through October). The variability of rainfall is well illustrated by the fact that 10.98 inches fell in May 1954, and 10.40 inches fell in May 1957, whereas in 1956, the total for the year was 10.28 inches.

Wintertime precipitation may fall as rain, freezing rain, snow, or sleet, or a combination of these. Snow is uncommon and much of it melts as it falls.

[4] This section was prepared by ROBERT B. ORTON, State climatologist, U.S. Weather Bureau.

TABLE 6.—*Precipitation data recorded at Crowell from 1931 through 1960*

Month	Rainfall							Snowfall, sleet		
	Mean	Total for month—		Heaviest rainfall in 1 day		1 year in 10 will have—		Mean	Heaviest snowfall in 1 month	
		In driest year (1956)	In wettest year (1941)			Less than—	More than—			
	In.	*In.*	*In.*	*In.*	*Yr.*	*In.*	*In.*	*In.*	*In.*	
January	0.96	0.27	3.56	1.76	1939	0.1	2.6	1.3	[1]6.5	1940
February	1.11	1.16	1.66	2.10	1938	0.1	2.4	1.2	7.0	1938
March	1.16	0	0.75	2.10	1934	0.1	2.7	1.1	[1]10.0	1931
April	2.08	0	4.39	[2]3.02	1943	0.3	4.3	([3])	([3])	1939
May	4.97	2.52	9.08	[2]4.25	1951	1.3	9.8	0	0	--------
June	2.56	0.15	6.87	[2]2.10	1943	0.1	5.3	0	0	--------
July	1.92	0.83	0	4.60	1953	0.1	5.4	0	0	--------
August	1.91	0.39	2.98	3.20	1945	0.2	4.5	0	0	--------
September	2.50	0.17	3.34	4.00	1935	0.1	5.4	0	0	--------
October	2.56	3.15	5.78	4.85	1955	0.4	5.7	0	0	--------
November	1.22	0.32	0.35	2.15	1957	0.1	2.7	0.2	5.0	1957
December	1.14	1.32	1.07	2.00	1931	0.1	3.1	1.4	[1]14.0	1931
Year	24.09	10.28	39.83	4.85	1955 (Oct.)	19.3	33.4	5.2	14.0	1931 (Dec.)

[1] Exceeded in years prior to 1931 as follows:
10 inches in January 1925.
13 inches in March 1924.
6 inches in November 1918.

[2] Exceeded in years prior to 1931 as follows:
3.6 inches in April 1919.
6.3 inches in May 1929.
4.2 inches in June 1923.

[3] Trace.

Snowfall statistics are misleading in that the average for a long period is affected by occasional heavy snows. As shown in table 6, for example, during the period 1931 through 1960, the only November snowfall reported was in 1957, but this fall amounted to 5 inches. In 23 years of this 30-year period, no snow fell during the month of December, but in December 1931, 14 inches of snow fell; and in December 1942, 11 inches fell.

Foard County lies in the path of cold air masses that push down from the north in winter and early in spring. These "northers" result in abrupt temperature changes. Although the area is subjected to a wide range of temperatures from day to day, and sometimes from hour to hour, winters generally are relatively mild. Summers are hot; the daily maximum is often above 100 degrees. The high summer temperatures generally are accompanied by low humidity and breezes.

The prevailing wind is from either the south or southeast in all months except January and February, when there are frequent "northers." There is little variation in average wind velocity from month to month. The strongest winds are those associated with severe thunderstorms late in spring and early in summer.

Hailstorms may occur any time from about March through October but are more frequent late in spring and early in summer. Ordinarily, an individual hailstorm affects only a small area, and the degree of destruction varies considerably.

Sunshine is abundant the year round; cloudiness is most frequent in winter and late in spring. Humidity averages about 76 percent at 6:00 a.m. and about 50 percent at 6:00 p.m. It is lowest during the warmest part of the afternoon. The average annual rate of pan evaporation in the region is approximately 95 inches, and the rate of evaporation from lake surfaces is approximately 66 inches. Approximately 68 percent of the average annual pan evaporation occurs during the period May through October (*3*).

Freeze data for Foard County have been estimated from isopleths of late spring and early fall low temperatures (*2*).

The average date of the last occurrence of a 32° temperature in spring is April 1, and the average date of the first occurrence of a 32° temperature in fall is November 10. Thus, the average freeze-free season is approximately 220 days. There is a 20 percent chance of a freezing temperature later than April 10 in spring and earlier than October 27 in fall. There is a 5 percent chance of a freezing temperature later than April 20 in spring and earlier than October 20 in fall. The average number of days between the last occurrence of 28° in spring and the first occurrence in fall is approximately 250 days.

Glossary

Aggregate, soil. Many fine soil particles held in a single mass or cluster, such as a clod, crumb, block, or prism.

Alluvium. Soil material, such as gravel, sand, silt, or clay, that has been deposited on land by streams.

Binder, soil. Soil particles, generally smaller than No. 200 sieve size, that cause cohesion in materials used for surfacing roads.

Calcareous soil. A soil containing enough calcium carbonate to effervesce (fizz) when treated with cold, dilute hydrochloric acid.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors that consist of concentrations of compounds or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose. Noncoherent; will not hold together in a mass.

Friable. When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

Firm. When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic. When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky. When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard. When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft. When dry, breaks into powder or individual grains under very slight pressure.

Cemented. Hard and brittle; little affected by moistening.

Dune. A mound or ridge of loose sand piled up by the wind. In this county, dunes generally are less than 10 feet high and have a gradient of more than 8 percent.

Field moisture equivalent. The minimum moisture content at which a smooth soil surface will absorb no more water in 30 seconds when the water is added in individual drops. It is the moisture content required to fill all the pores in sands and to approach saturation in cohesive soils.

Gravel. A soil separate, rounded or angular, 2.0 millimeters to 80 millimeters in diameter. The content of gravel is not used in determining the textural class of the soil, but if the soil is 20 percent or more gravel, the word "gravelly" is applied as a prefix to the textural soil name.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes (*9*). These are the major horizons:

A horizon. The mineral horizon at the surface. It has an accumulation of organic matter, has been leached of soluble minerals and clay, or shows the effects of both.

B horizon. The horizon in which clay minerals or other material has accumulated, that has developed a characteristic blocky or prismatic structure, or that shows the effects of both processes.

C horizon. The unconsolidated material immediately under the true soil. It is presumed to be similar in chemical, physical, and mineral composition to the material from which at least a part of the overlying solum has developed.

Hummocky. Irregular or choppy topography characterized by small dunes or mounds that are 3 to 10 feet high and have a gradient of 3 to 8 percent.

Loam. The textural class name for soil that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand.

Outwash. Cross-bedded gravel, sand, silt, and clay deposited by meltwater as it flowed from glacial ice; overwash. In this county, outwash refers to soil material that was washed from areas in the High Plains and Rocky Mountains by meltwater, carried in streams, and deposited on the Permian red beds during the Pleistocene epoch.

Parent material. The weathered rock or partly weathered soil material from which soil has formed; horizon C in the soil profile.

Permeability, soil. The quality of a soil horizon that enables water or air to move through it. Terms used to describe permeability are as follows: *Very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.* Permeability of a soil may be limited by the presence of one nearly impermeable horizon, even though the others are permeable. Moderately permeable soils transmit air and water readily, a condition that is favorable for the growth of roots. Slowly permeable soils allow water and air to move so slowly that root growth is restricted. Rapidly permeable soils transmit air and water rapidly, and root growth is good.

pH. A numerical designation of the relative acidity or alkalinity of soils and other biological systems. Technically, pH is the common logarithm of the reciprocal of the hydrogen-ion concentration of a solution. A pH of 7.0 indicates precise neutrality; higher values indicate increasing alkalinity, and lower values indicate increasing acidity. See also Reaction, soil.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material. See Horizon, soil.

Reaction, soil. The degree of acidity or alkalinity of a soil mass, expressed either in pH value or in words, as follows:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.0 and higher

Relief. The elevations or inequalities of a land surface, considered collectively; also, the difference in elevation between the hilltops, or summits, and the lowlands of a region.

Residual material. Unconsolidated, partly weathered mineral material that accumulates over disentegrating solid rock. Residual material is not soil but is frequently the material in which a soil has formed.

Saline soil. A soil that contains soluble salts in amounts that impair growth of crop plants but does not contain excess exchangeable sodium.

Sand. As a soil separate, individual rock or mineral fragments 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains are quartz, but sand may be of any mineral composition. As a textural class, soil that is 85 percent or more sand and not more than 10 percent clay.

Silt. As a soil separate, individual mineral particles 0.002 millimeter to 0.05 millimeter in diameter. As a textural class, soil that is 80 percent or more silt and less than 12 percent clay.

Slick spots. Alkali spots. Small areas that are slick when wet because the soil contains excess exchangeable sodium, or alkali.

Soil depth classes. As used in this report, *very shallow* is equivalent to 0 to 10 inches; *shallow*, 10 to 20 inches; *moderately deep*, 20 to 36 inches; and *deep*, 36 inches or more.

Soil separates. Mineral particles less than 2 millimeters in equivalent diameter and ranging between specified size limits. The names and sizes of separates recognized in the United States are as follows: *Very coarse sand*, 2.0 to 1.0 millimeter; *coarse sand*, 1.0 to 0.5 millimeter; *medium sand*, 0.5 to 0.25 millimeter; *fine sand*, 0.25 to 0.10 millimeter; *very fine sand*, 0.10 to 0.05 millimeter; *silt*, 0.05 to 0.002 millimeter; *clay*, less than 0.002 millimeter.

Soil slope. The incline of the surface of a soil, generally expressed as a percentage; that is, the number of feet of fall per 100 feet of horizontal distance. The slope classes used in this report are as follows: *Nearly level*, 0 to 1 percent; *gently sloping*, 1 to 3 percent; *moderately sloping*, 3 to 5 percent; *sloping*, 5 to 8 percent; *strongly sloping*, 8 to 12 percent; *moderately steep*, 12 to 20 percent; *steep*, 20 percent or more.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in a mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are as follows: *platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. Structureless soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering without any regular cleavage, as in many claypans and hardpans).

Subsoil. Technically, the B horizon; roughly, the part of the profile below plow depth.

Substratum. Any layer beneath the solum, or true soil. The term is applied both to parent material and to other layers unlike the parent material that lie below the B horizon or the subsoil.

Surface soil. The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, about 5 to 8 inches thick.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay*, and *clay*. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine." Sand and loamy sand can be grouped as *coarse-textured soils;* fine sandy loam is *moderately coarse textured;* very fine sandy loam, loam, silt loam, and silt are *medium-textured soils;* clay loam, sandy clay loam, and silty clay loam are *moderately fine textured soils;* sandy clay, silty clay, and clay are *fine-textured soils.*

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GUIDE TO MAPPING UNITS

[See table 1, p. 7, for approximate acreage and proportionate extent of soils; table 2, p. 35, for estimated average acre yields; and table 4 p. 42, and table 5, p. 50, for engineering properties of soils]

Map Symbol	Mapping unit	Page	Capability unit Symbol	Capability unit Page	Range site Name	Range site Page
AbA	Abilene clay loam, 0 to 1 percent slopes	7	IIc-1	29	Deep Hardland	38
AbB	Abilene clay loam, 1 to 3 percent slopes	8	IIe-1	27	Deep Hardland	38
AbB2	Abilene clay loam, 1 to 3 percent slopes, eroded	8	IIIe-2	29	Deep Hardland	38
Ak	Abilene-slickspot complex	8	IIIs-2	31	Deep Hardland	38
Am	Altus fine sandy loam	9	IIe-4	28	Sandy Loam	38
Ba	Badland	9	VIIIs-1	33	-------------	
CoB	Cobb fine sandy loam, 1 to 3 percent slopes	10	IIIe-7	31	Sandy Loam	38
Cs	Cobb fine sandy loam, shallow variant	10	IVe-3	32	Sandy Loam	38
Cu	Cobb-Quinlan complex:					
	Cobb	10	IVe-3	32	Sandy Loam	38
	Quinlan	10	VIe-2	32	Sandy Loam	38
Cw	Cottonwood-Acme complex:					
	Cottonwood	10	VIIs-1	33	Gyp Land	38
	Acme	10	IVe 3	32	Deep Hardland	38
Cx	Cottonwood-Ector-Vernon complex:					
	Cottonwood	10	VIIs-1	33	Gyp Land	38
	Ector	10	VIIs 1	33	Very Shallow	40
	Vernon	10	VIe-2	32	Shallow Redland	40
Cy	Cottonwood-Vernon-Acme complex:					
	Cottonwood	11	VIIs-1	33	Gyp Land.	38
	Vernon	11	VIe-2	32	Shallow Redland.	40
	Acme	11	IVe-3	32	Deep Hardland.	38
Ec	Ector soils	12	VIIs-1	33	Very Shallow.	40
EfA	Enterprise fine sandy loam, 0 to 1 percent slopes	13	IIe-6	28	Sandy Loam.	38
EfB	Enterprise fine sandy loam, 1 to 3 percent slopes	13	IIIe-5	30	Sandy Loam.	38
EnA	Enterprise very fine sandy loam, 0 to 1 percent slopes	13	IIc-2	29	Mixed Land.	39
EnB	Enterprise very fine sandy loam, 1 to 3 percent slopes	13	IIe-3	27	Mixed Land.	39
EnC	Enterprise very fine sandy loam, 3 to 5 percent slopes	13	IIIe-3	30	Mixed Land.	39
Gr	Gravelly rough land	13	VIs-1	33	Gravelly.	39
HcA	Hollister clay loam, 0 to 1 percent slopes	14	IIc-1	29	Deep Hardland.	38
HcB	Hollister clay loam, 1 to 3 percent slopes	14	IIe-1	27	Deep Hardland.	38
HcB2	Hollister clay loam, 1 to 3 percent slopes, eroded	14	IIIe 2	29	Deep Hardland.	38
LaB	La Casa clay loam, 1 to 3 percent slopes	15	IIe-2	27	Deep Hardland.	38
Lc	La Casa-Ector complex:					
	La Casa	15	IIe-2	27	Deep Hardland.	38
	Ector	15	VIIs-1	33	Very Shallow.	40
Lo	Loamy alluvial land	15	Vw-1	32	Loamy Bottomland.	38
MfA	Miles fine sandy loam, 0 to 1 percent slopes	17	IIe-4	28	Sandy Loam.	38
MfB	Miles fine sandy loam, 1 to 3 percent slopes	17	IIe-5	28	Sandy Loam.	38
MfC	Miles fine sandy loam, 3 to 5 percent slopes	17	IIIe-4	30	Sandy Loam.	38
MmB	Miles loamy fine sand, 0 to 3 percent slopes	16	IIIe-6	30	Sandy Land.	39
Mr	Miller clay	17	IIIs-1	31	Clay Flats.	40
Ra	Randall clay	18	IVw-1	32	Deep Hardland.	38
Sa	Sandy alluvial land	18	Vw-2	32	Sandy Bottomland.	37
Sg	Springer loamy fine sand, undulating	19	IVe-2	31	Sandy Land.	39
Sp	Springer loamy fine sand, hummocky	19	VIe-1	32	Sandy Land.	39
Sr	Spur silt loam	19	I-1	27	Loamy Bottomland.	38
Su	Spur clay loam	19	I-1	27	Loamy Bottomland.	38
Sy	Spur and Miller clay loams:					
	Spur	20	IIc-1	29	Loamy Bottomland.	38
	Miller	20	IIc-1	29	Deep Hardland.	38
TcA	Tillman clay loam, 0 to 1 percent slopes	20	IIs-1	28	Deep Hardland.	38
TcB	Tillman clay loam, 1 to 3 percent slopes	21	IIIe-1	29	Deep Hardland.	38
TcB2	Tillman clay loam, 1 to 3 percent slopes, eroded	21	IVe-1	31	Deep Hardland.	38
Tp	Tipton silt loam	22	IIc-2	29	Mixed Land.	39
Tv	Tivoli fine sand	22	VIIe-1	33	Deep Sand.	38
Vb	Vernon-badland complex:					
	Vernon	22	IVe-3	32	Shallow Redland.	40
	Badland	22	VIIIs-1	33	------------------------	
VcB	Vernon-Weymouth clay loams, 1 to 3 percent slopes:					
	Vernon	23	IVe-3	32	Shallow Redland.	40
	Weymouth	23	IVe-3	32	Deep Hardland.	38
VcC	Vernon-Weymouth clay loams, 3 to 5 percent slopes:					
	Vernon	23	VIe-2	32	Shallow Redland.	40
	Weymouth	23	VIe-2	32	Deep Hardland.	38
WcB	Wichita clay loam, 1 to 3 percent slopes	24	IIe-1	27	Deep Hardland.	38
WmA	Wichita loam, 0 to 1 percent slopes	24	IIc-1	29	Deep Hardland.	38
WmB	Wichita loam, 1 to 3 percent slopes	24	IIe-1	27	Deep Hardland.	38
Ya	Yahola very fine sandy loam	25	I-1	27	Loamy Bottomland.	38

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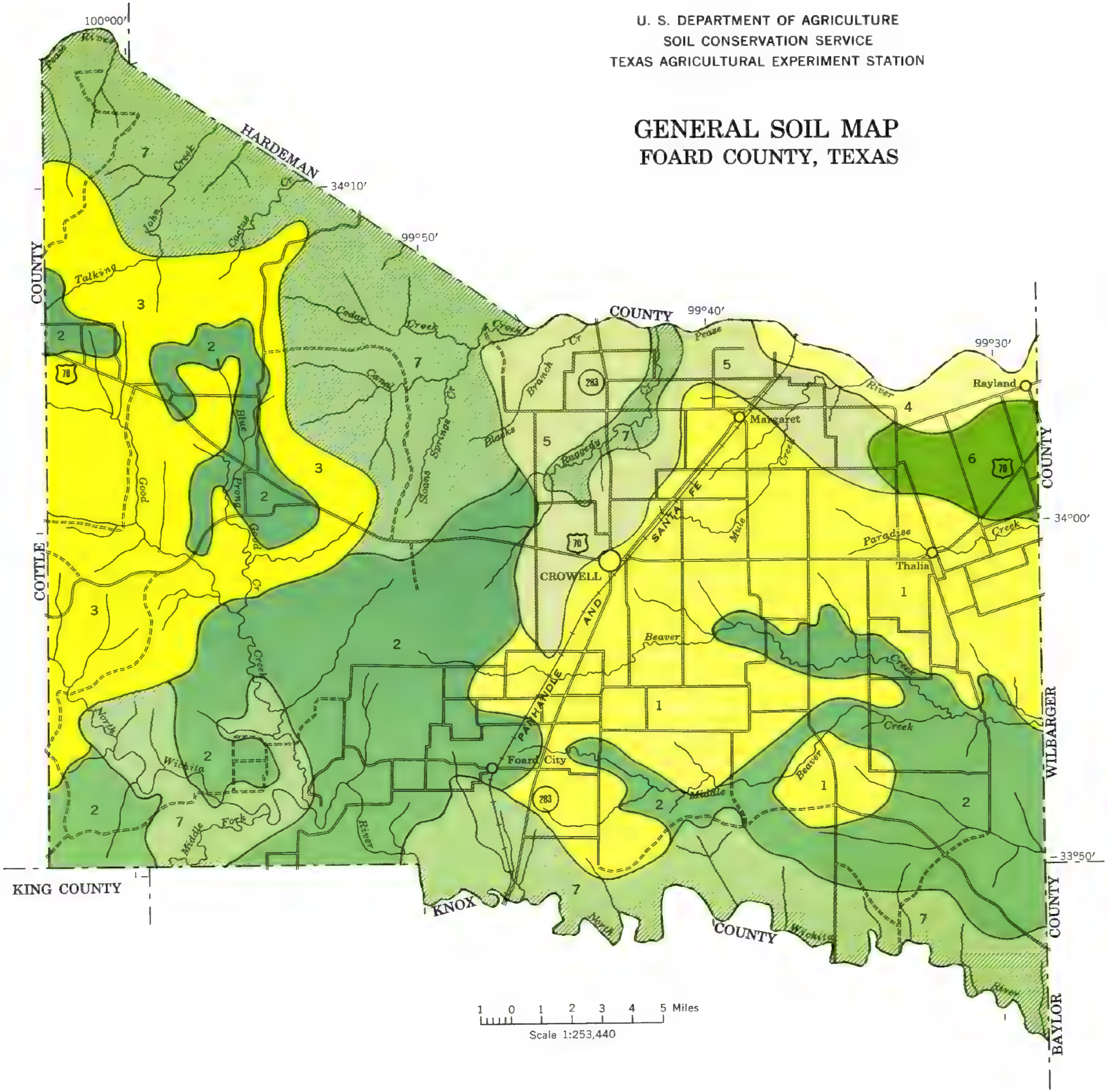
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEXAS AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP
FOARD COUNTY, TEXAS



SOIL ASSOCIATIONS

1 Abilene-Hollister association: nearly level hardland soils

2 Tillman-Vernon association: sloping hardland soils

3 La Casa-Ector association: sloping hardland soils and shallow soils

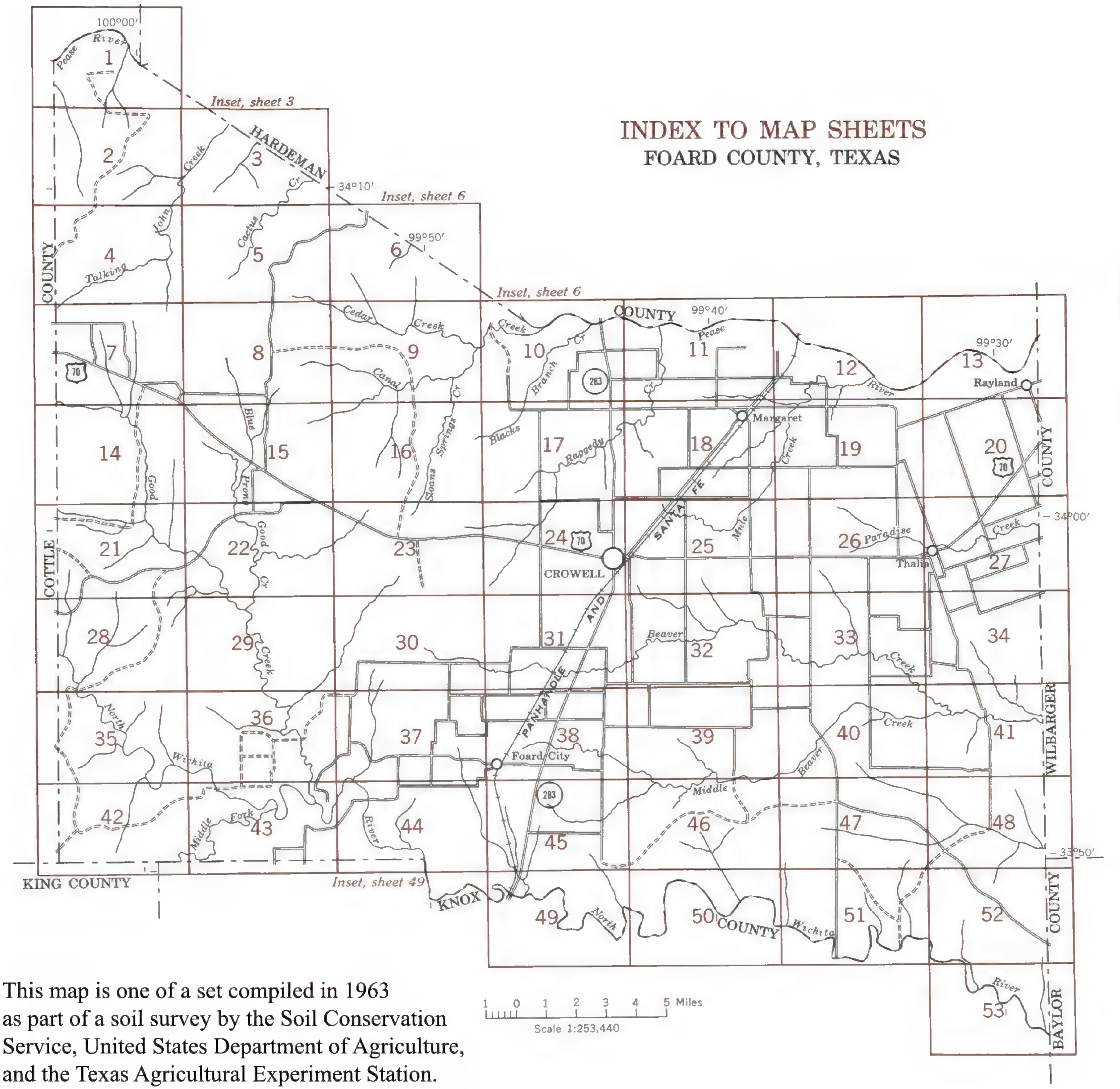
4 Enterprise-Tipton association: mixed land

5 Wichita-Miles association: moderately sandy soils

6 Miles-Springer association: sandy soils

7 Rough broken land association: rough land

January 1964



This map is one of a set compiled in 1963 as part of a soil survey by the Soil Conservation Service, United States Department of Agriculture, and the Texas Agricultural Experiment Station. Land division corners and numbers shown on this map are indefinite.

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, or D, shows the slope. Some symbols without a slope letter are for nearly level soils or land types, but some are for soils or land types that have a considerable range of slope. A final number, 2, in the symbol shows that the soil is eroded. (W) following the soil name indicates that signs of erosion, especially of local shifting of soil by wind, are evident in some places, but the degree of erosion cannot be estimated reliably.

SYMBOL	NAME
AbA	Abilene clay loam, 0 to 1 percent slopes
AbB	Abilene clay loam, 1 to 3 percent slopes
AbB2	Abilene clay loam, 1 to 3 percent slopes, eroded
Ak	Abilene-slickspot complex
Am	Altus fine sandy loam
Ba	Badland
CoB	Cobb fine sandy loam, 1 to 3 percent slopes
Cs	Cobb fine sandy loam, shallow variant
Cq	Cobb-Quinlan complex
Cw	Cottonwood-Acme complex
Cx	Cottonwood-Ector-Vernon complex
Cy	Cottonwood-Vernon-Acme complex
Ec	Ector soils
EfA	Enterprise fine sandy loam, 0 to 1 percent slopes (W)
EfB	Enterprise fine sandy loam, 1 to 3 percent slopes (W)
EnA	Enterprise very fine sandy loam, 0 to 1 percent slopes
EnB	Enterprise very fine sandy loam, 1 to 3 percent slopes
EnC	Enterprise very fine sandy loam, 3 to 5 percent slopes
Gr	Gravelly rough land
HcA	Hollister clay loam, 0 to 1 percent slopes
HcB	Hollister clay loam, 1 to 3 percent slopes
HcB2	Hollister clay loam, 1 to 3 percent slopes, eroded
LaB	La Casa clay loam, 1 to 3 percent slopes
Lc	La Casa-Ector complex
Lo	Loamy alluvial land
MfA	Miles fine sandy loam, 0 to 1 percent slopes
MfB	Miles fine sandy loam, 1 to 3 percent slopes
MfC	Miles fine sandy loam, 3 to 5 percent slopes
MmB	Miles loamy fine sand, 0 to 3 percent slopes (W)
Mr	Miller clay
Ra	Randall clay
Sa	Sandy alluvial land
Sg	Springer loamy fine sand, undulating (W)
Sp	Springer loamy fine sand, hummocky (W)
Sr	Spur silt loam
Su	Spur clay loam
Sy	Spur and Miller clay loams
TcA	Tillman clay loam, 0 to 1 percent slopes
TcB	Tillman clay loam, 1 to 3 percent slopes
TcB2	Tillman clay loam, 1 to 3 percent slopes, eroded
Tp	Tipton silt loam
Tv	Tivoli fine sand (W)
Vb	Vernon-badland complex
VcB	Vernon-Weymouth clay loams, 1 to 3 percent slopes
VcC	Vernon-Weymouth clay loams, 3 to 5 percent slopes
WcB	Wichita clay loam, 1 to 3 percent slopes
WmA	Wichita loam, 0 to 1 percent slopes
WmB	Wichita loam, 1 to 3 percent slopes
Ya	Yahola very fine sandy loam

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Dual
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail, foot
- Railroad
- Ferries
- Ford
- Grade
- R. R. over
- R. R. under
- Tunnel

Buildings
- School
- Church
- Station

Mines and Quarries

Mine dump

Pits, gravel or caliche

Power lines

Pipe lines

Cemeteries

Dams

Levees

Tanks

Oil wells

Windmills

BOUNDARIES

- National or state
- County
- Reservation
- Land grant
- Land division corners

DRAINAGE

Streams
- Perennial
- Intermittent, unclass.

Canals and ditches — CANAL, DITCH

Lakes and ponds
- Perennial
- Intermittent

Wells — flowing

Springs

Marsh

Wet spot

RELIEF

Escarpments
- Bedrock
- Other

Prominent peaks

Depressions — Large, Small

SOIL SURVEY DATA

Soil boundary and symbol — Dx

Gravel or caliche

Stones

Rock outcrops

Chert fragments

Clay spot

Sand spot

Gumbo or scabby spot

Made land

Severely eroded spot

Blowout, wind erosion

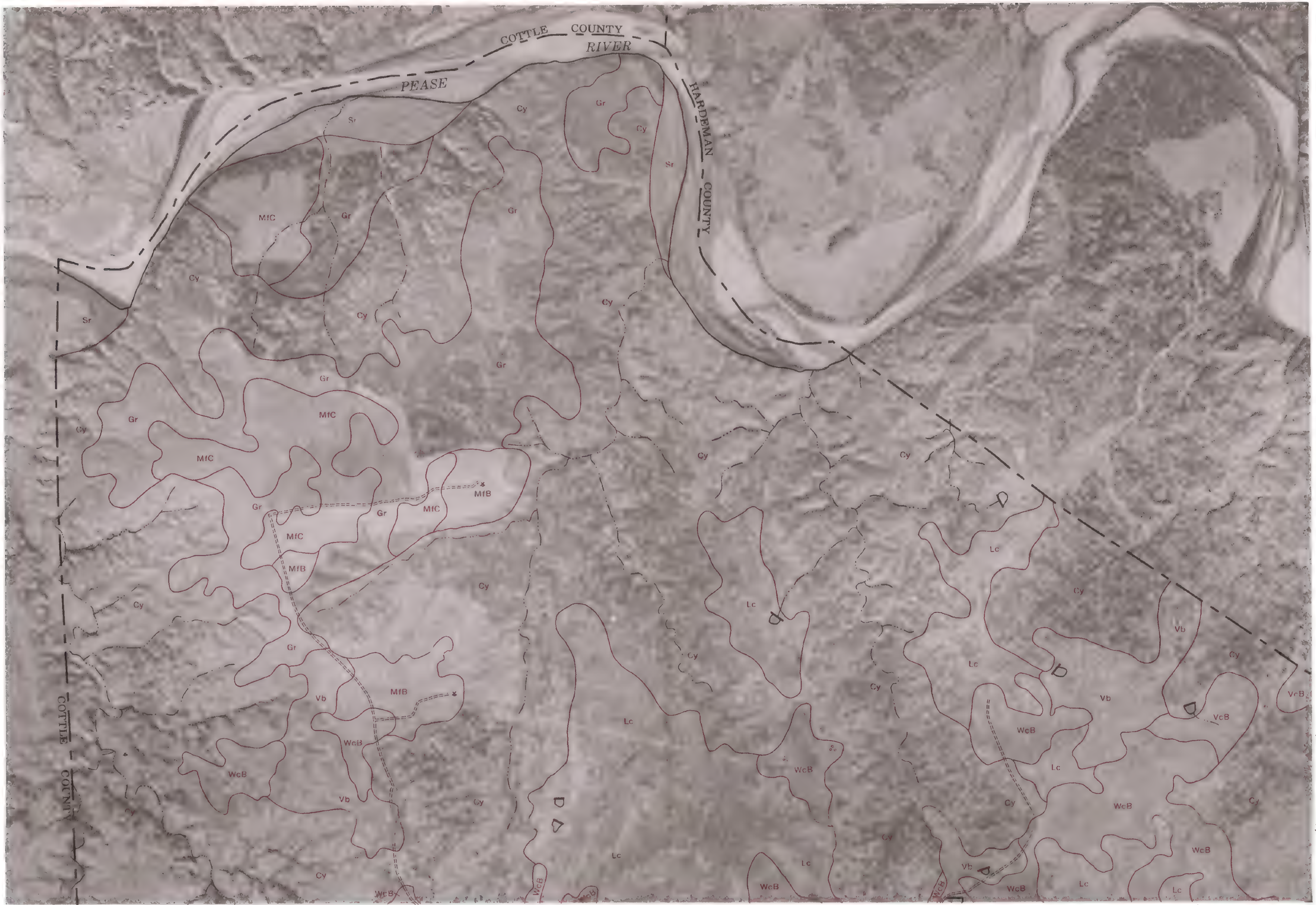
Gully

Saline spot

Soil map constructed 1963 by Cartographic Division, Soil Conservation Service, USDA, from 1956 aerial photographs. Controlled mosaic based on Texas plane coordinate system, north central zone, Lambert conformal conic projection. 1927 North American datum.

1

N



(Joins inset, sheet 3)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

(Joins sheet 2)

10

(Inset sh 6)

N

(Joins sheet 9)

(Joins sheet 11)

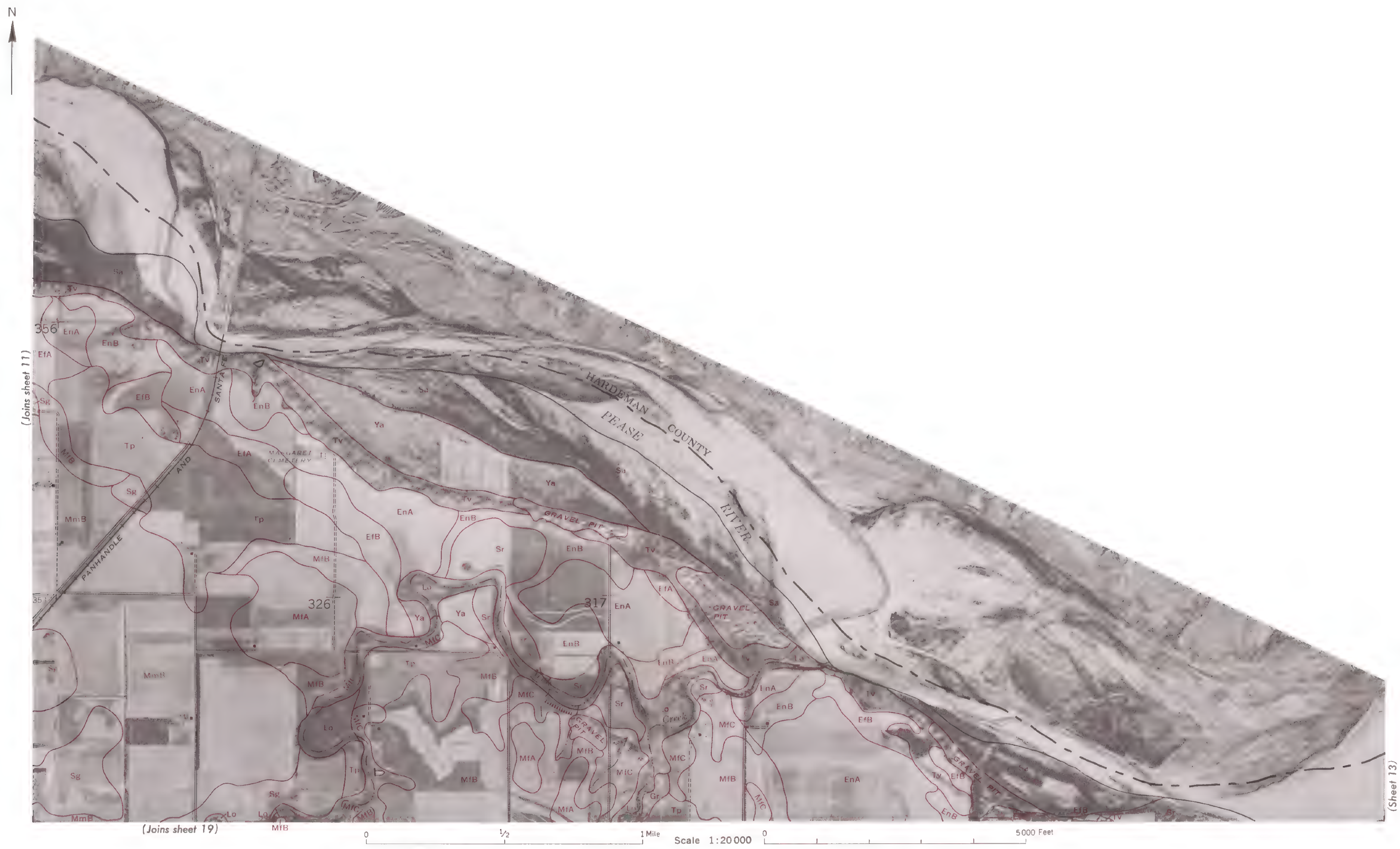
(Joins sheet 17)

0 1/2 1 Mile Scale 1:20 000 0 5000 Feet

11

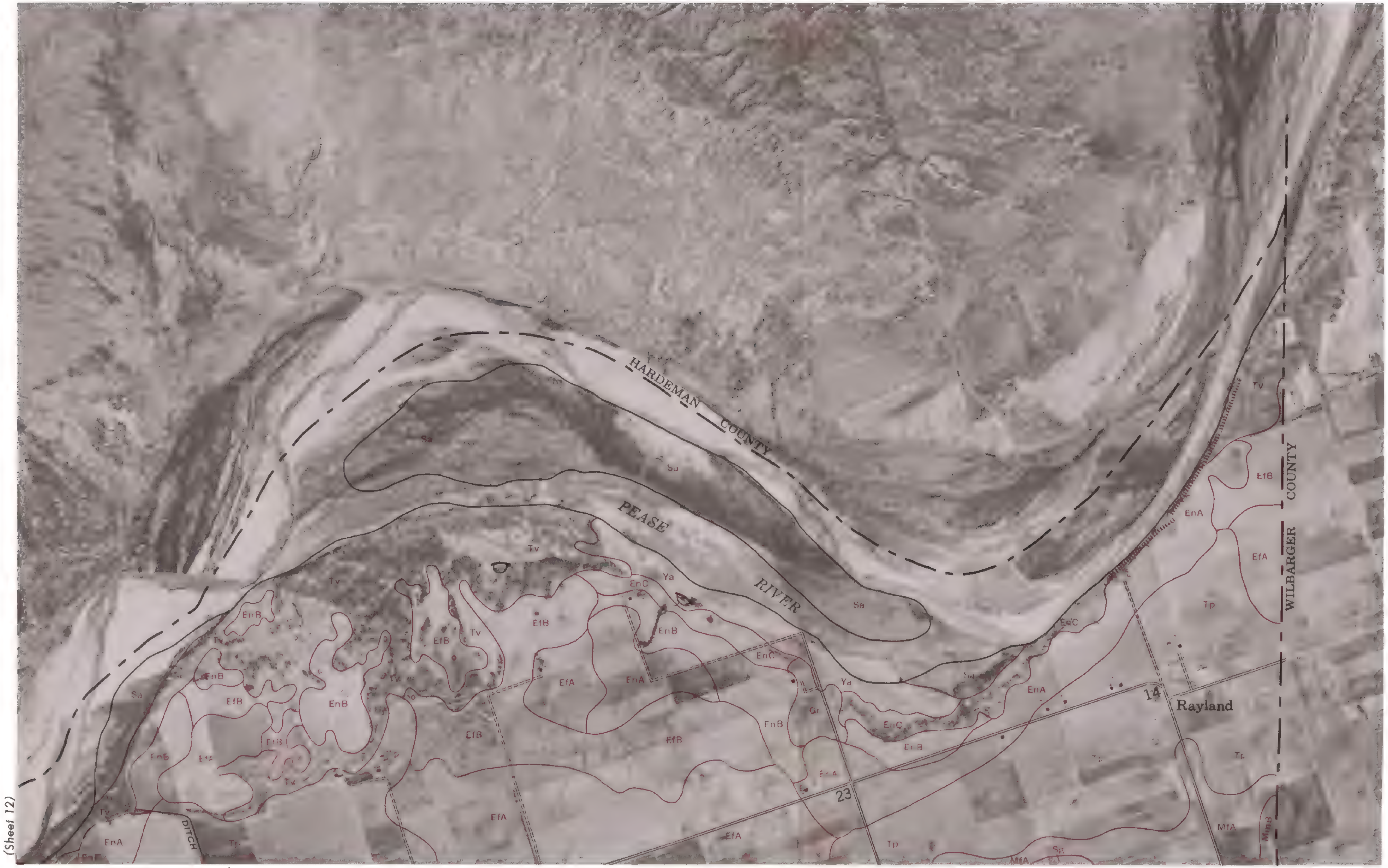
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(12)


N
(Joins sheet 11)
(Joins sheet 19)
(Sheet 13)
HARDEMAN
COUNTY
PEASE
RIVER
SANTA FE
AND
PANHANDLE
MARGARET CEMETERY
GRAVEL PIT
Creek
356
326
317
0
1/2
1 Mile
Scale 1:20 000
0
5000 Feet

N

(Sheet 12)



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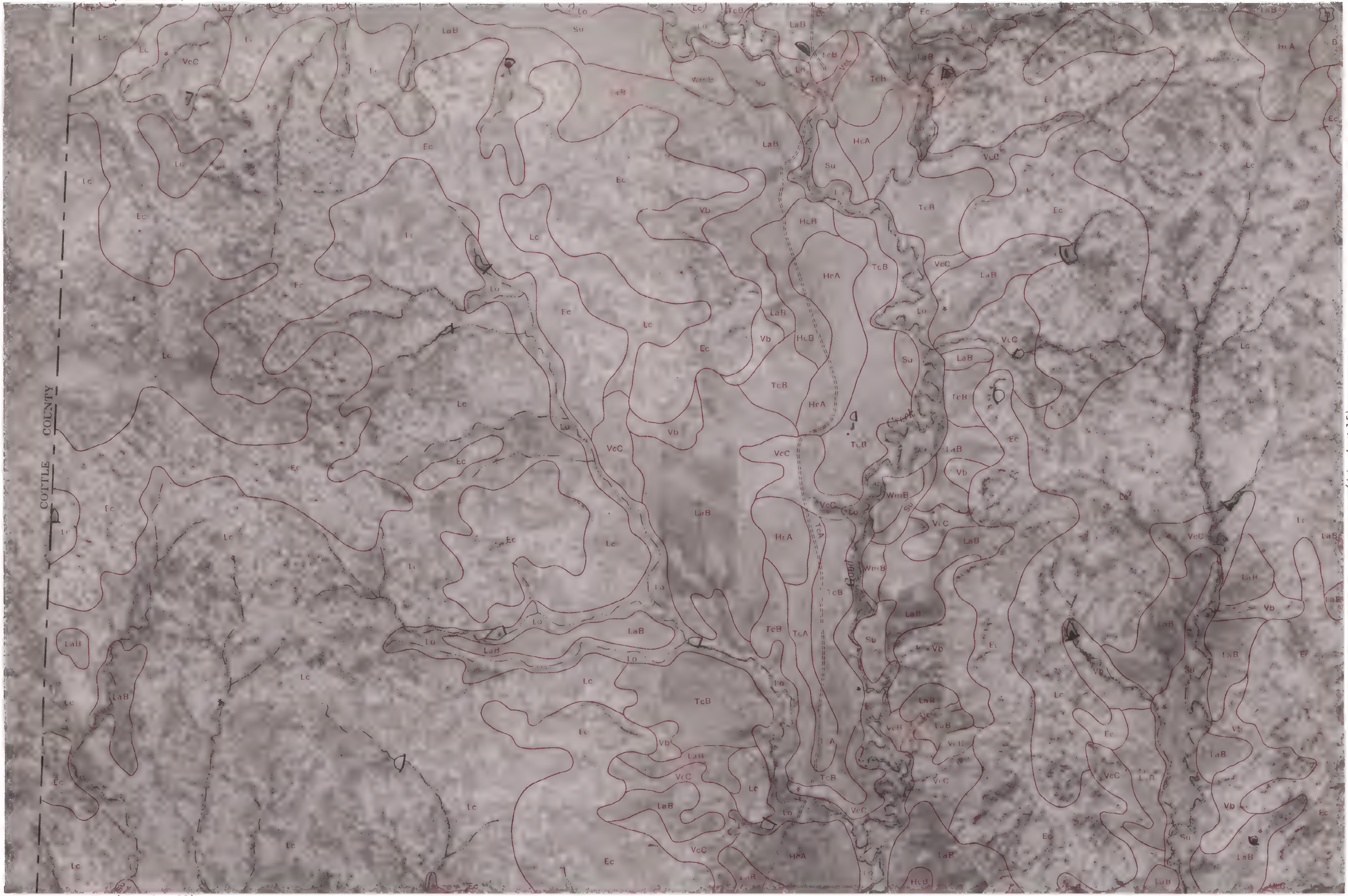
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

14

(Joins sheet 7)



(Joins sheet 15)

(Joins sheet 21)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet


(Joins sheet 8)
15
N
(Joins sheet 16)
(Joins sheet 14)
(Joins sheet 22)
Blue
Good
Creek
70
36
35
34
0
1/2
1 Mile
Scale 1:20 000
0
5000 Feet


16
(Joins sheet 9)
N
(Joins sheet 15)
(Joins sheet 17)
(Joins sheet 23)
0
1/2
1 Mile
Scale 1:20 000
0
5000 Feet
TcB
Vb
Cy
Lo
Ba
Lc
LaB
VcC
VcB
Sandy Creek
Sloans Creek
26
23
27
22
25

FOARD COUNTY, TEXAS — SHEET NUMBER 17

(17)

(Joins sheet 10)

(Joins sheet 16)

(Joins sheet 18)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet

(Joins sheet 24)

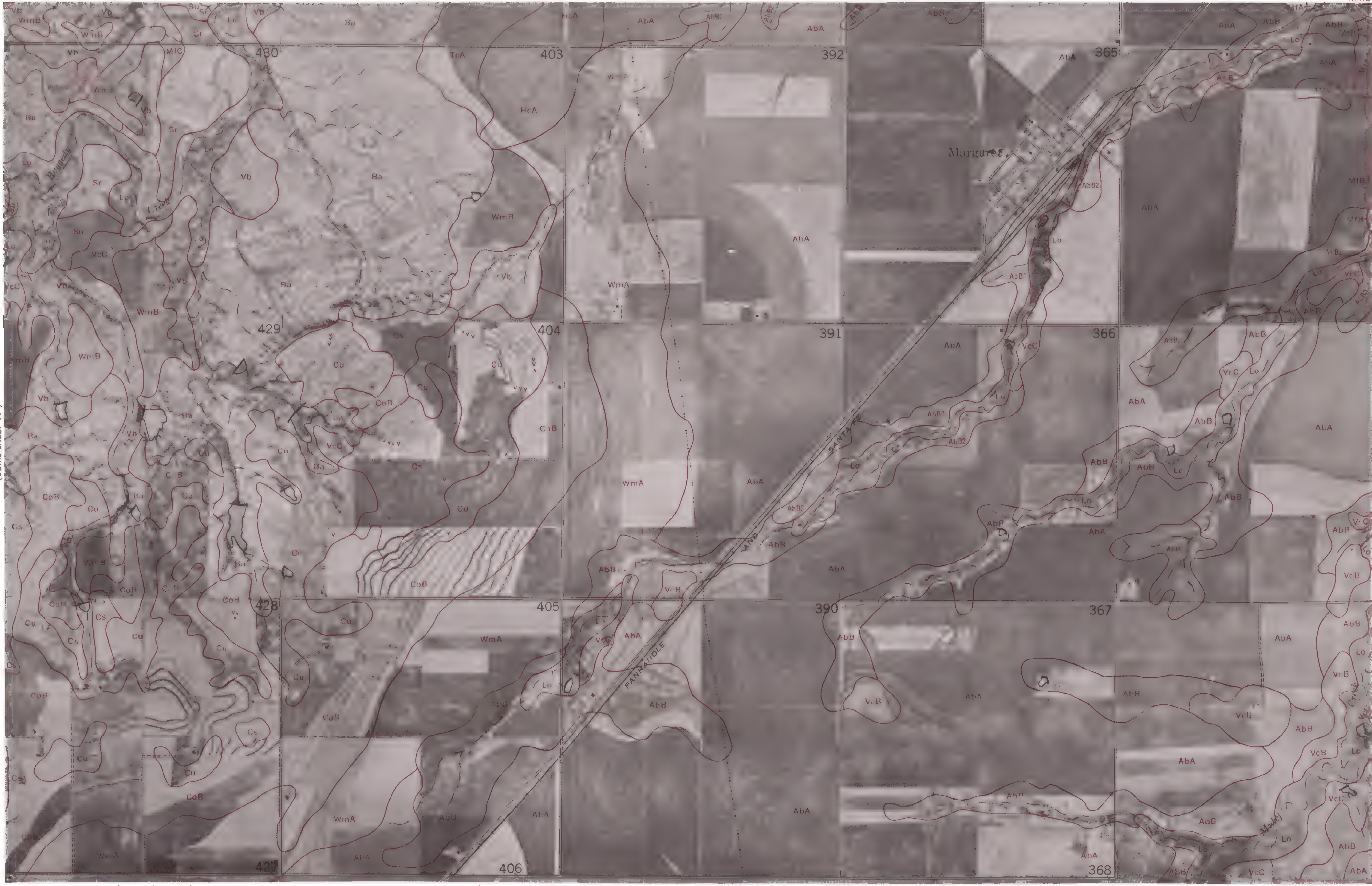
FOARD COUNTY, TEXAS — SHEET NUMBER 18

(18)

N

(Joins sheet 11)

(Joins sheet 17)



(Joins sheet 19)

(Joins sheet 25)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

FOARD COUNTY, TEXAS — SHEET NUMBER 19

(Joins sheet 12)

19

N

(Joins sheet 18)

(Joins sheet 20)

0 1/2 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 26)

FOARD COUNTY, TEXAS — SHEET NUMBER 2

2

(Joins sheet 1)

N

(Joins sheet 3)

(Joins sheet 4)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

(Joins sheet 13)

(Joins sheet 19)

(Joins sheet 27)

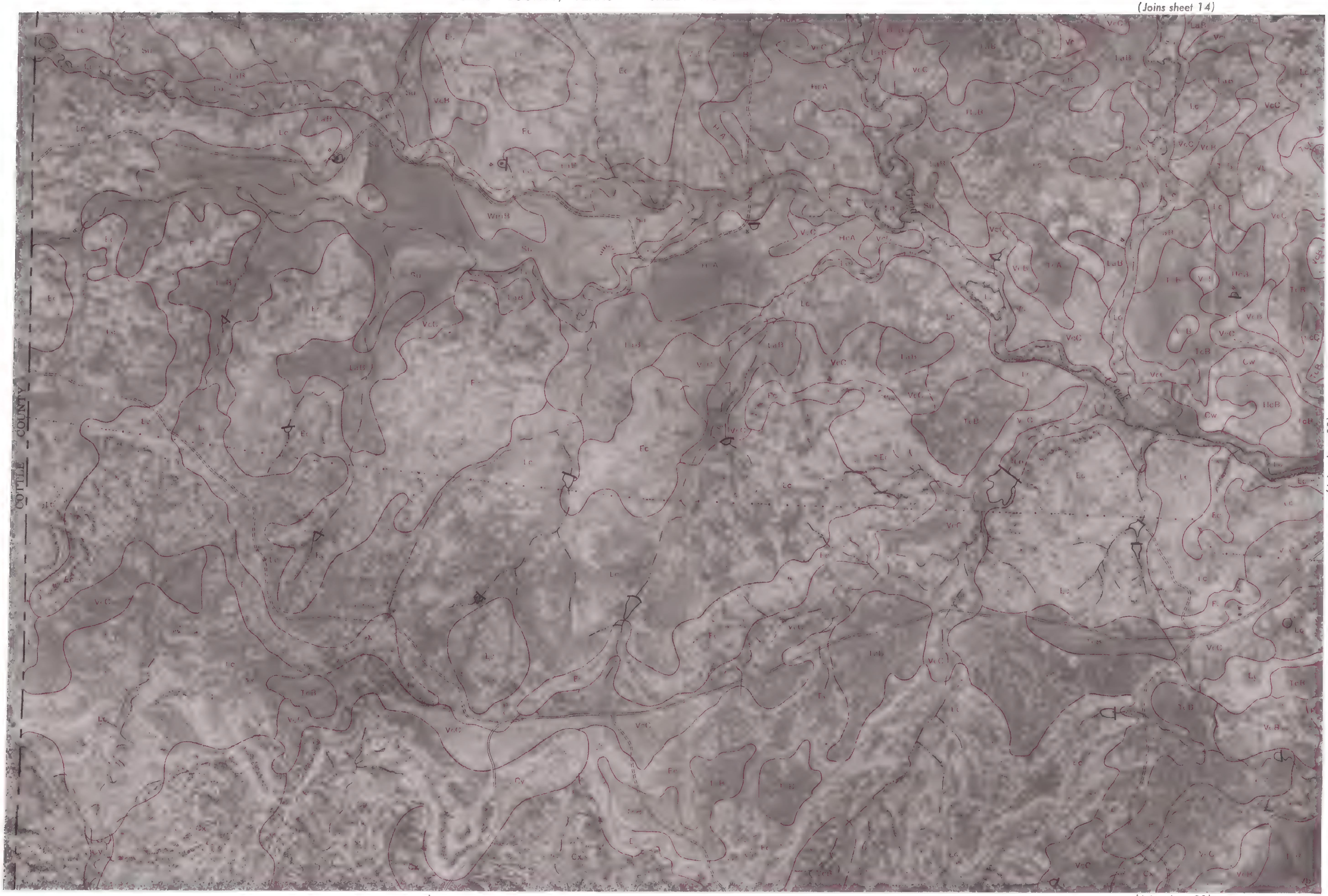
Scale 1:20 000

0 ½ 1 Mile

0 5000 Feet

(Joins sheet 14)

21



N

(Joins sheet 22)

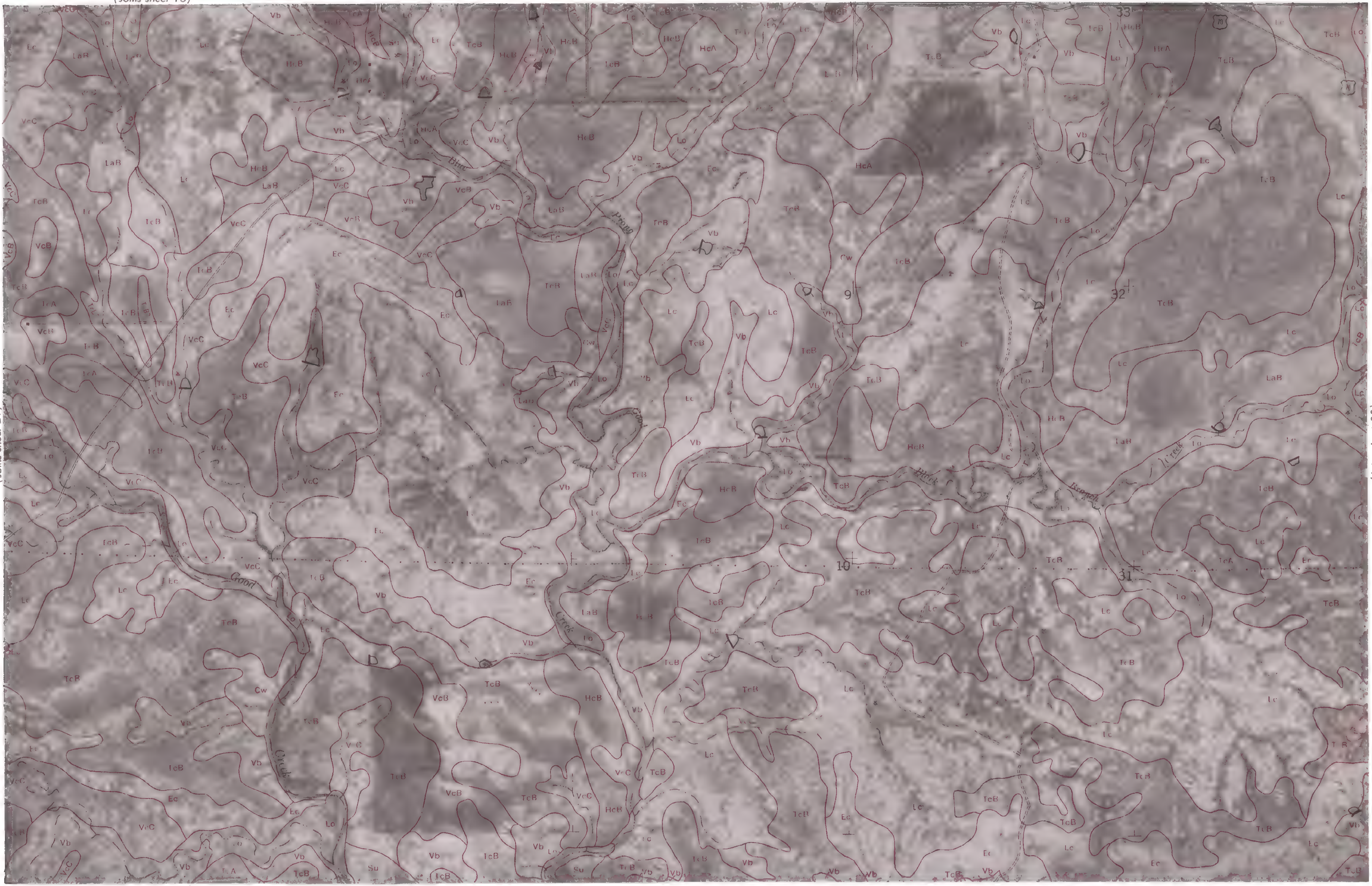
0 ½ 1 Mile Scale 1:20000 0 5000 Feet

(Joins sheet 28)

22

(Joins sheet 15)

(Joins sheet 21)



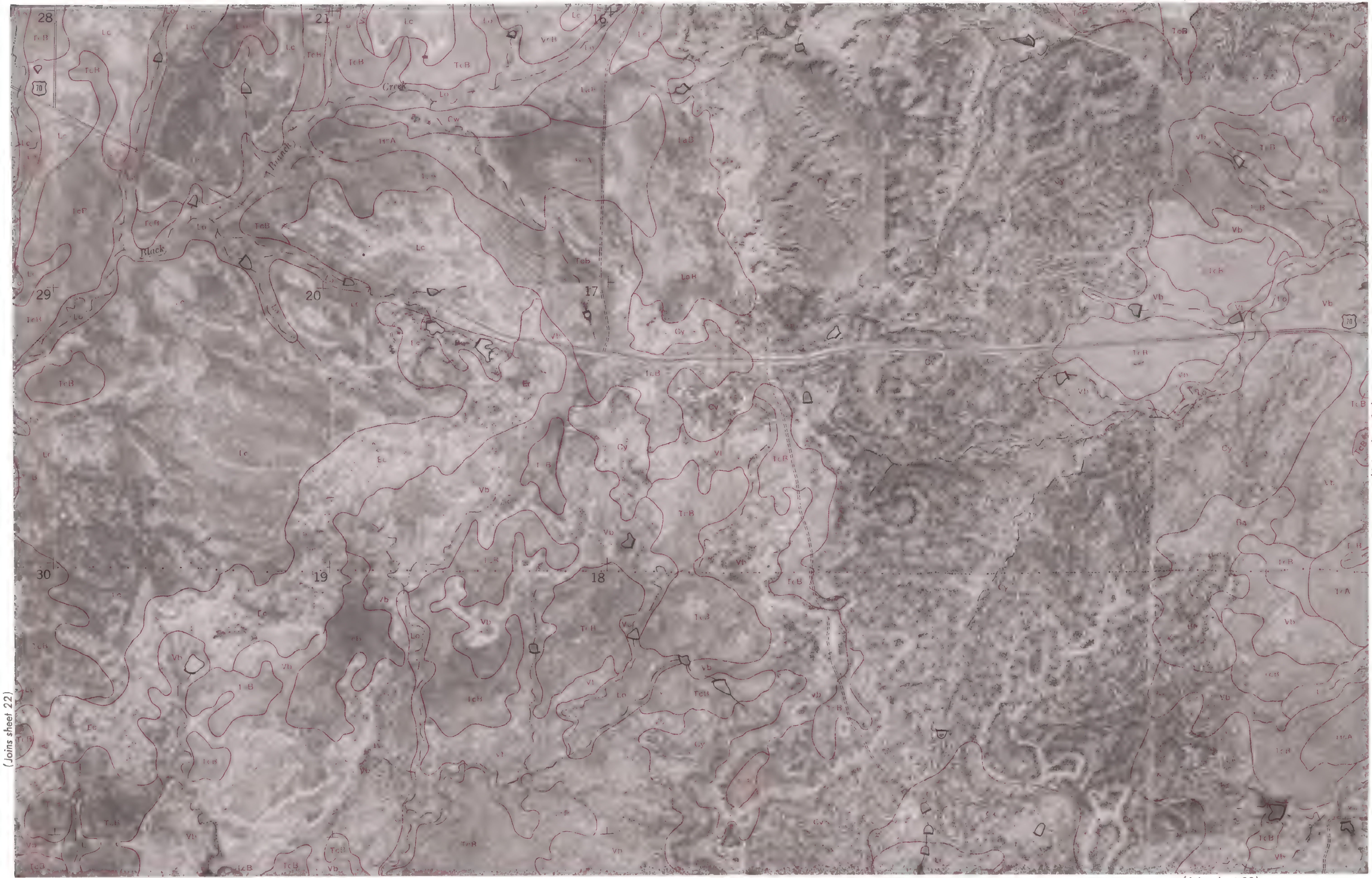
(Joins sheet 23)

(Joins sheet 29)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 16)

(Joins sheet 22)



(Joins sheet 24)

(Joins sheet 30)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

24

(Joins sheet 17)

N

(Joins sheet 23)

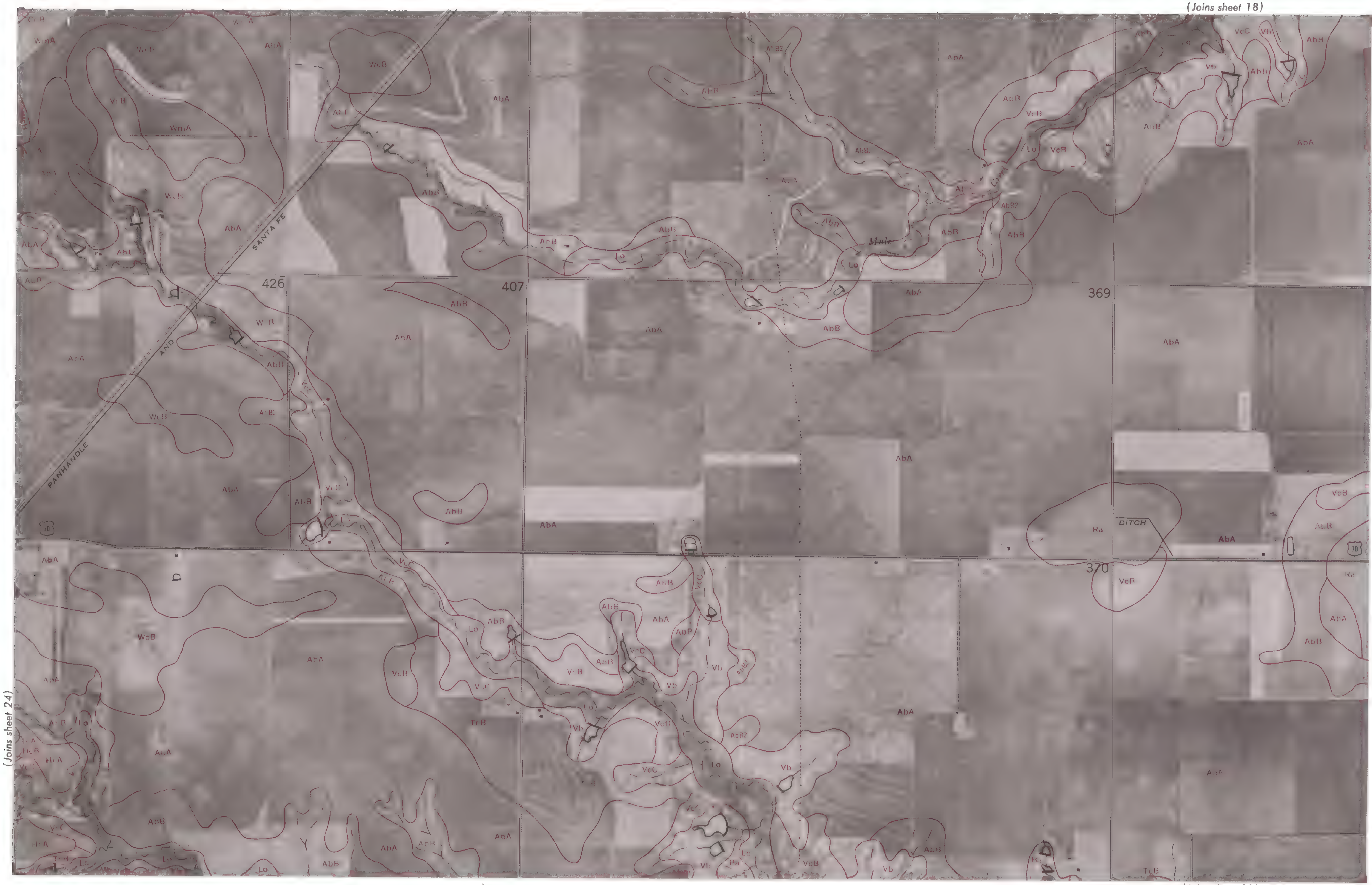
(Joins sheet 25)

(Joins sheet 31)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 18)

25



(Joins sheet 24)

(Joins sheet 26)

(Joins sheet 32)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

FOARD COUNTY, TEXAS — SHEET NUMBER 26

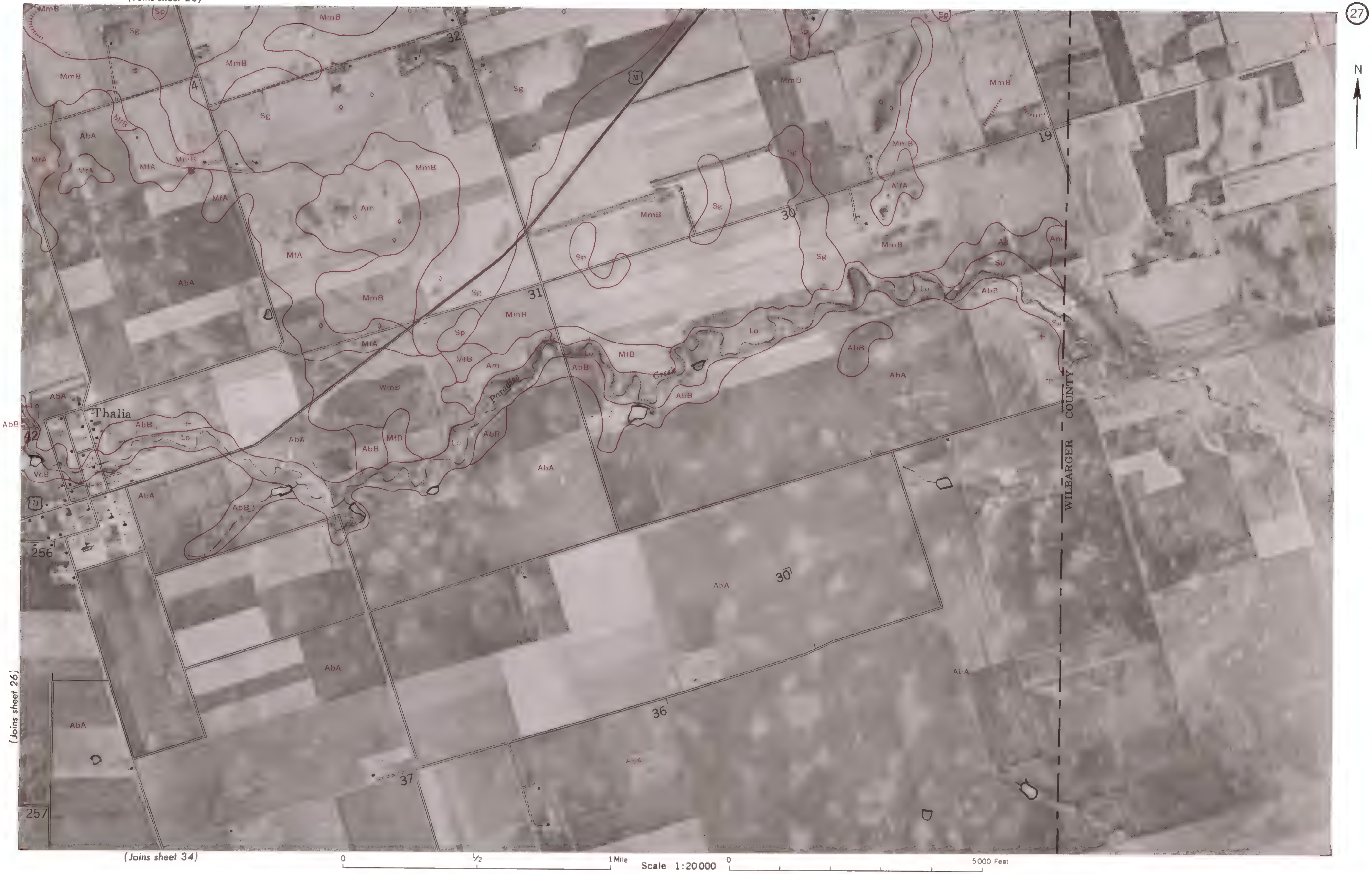
(26)

(Joins sheet 19)

(Joins sheet 33)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

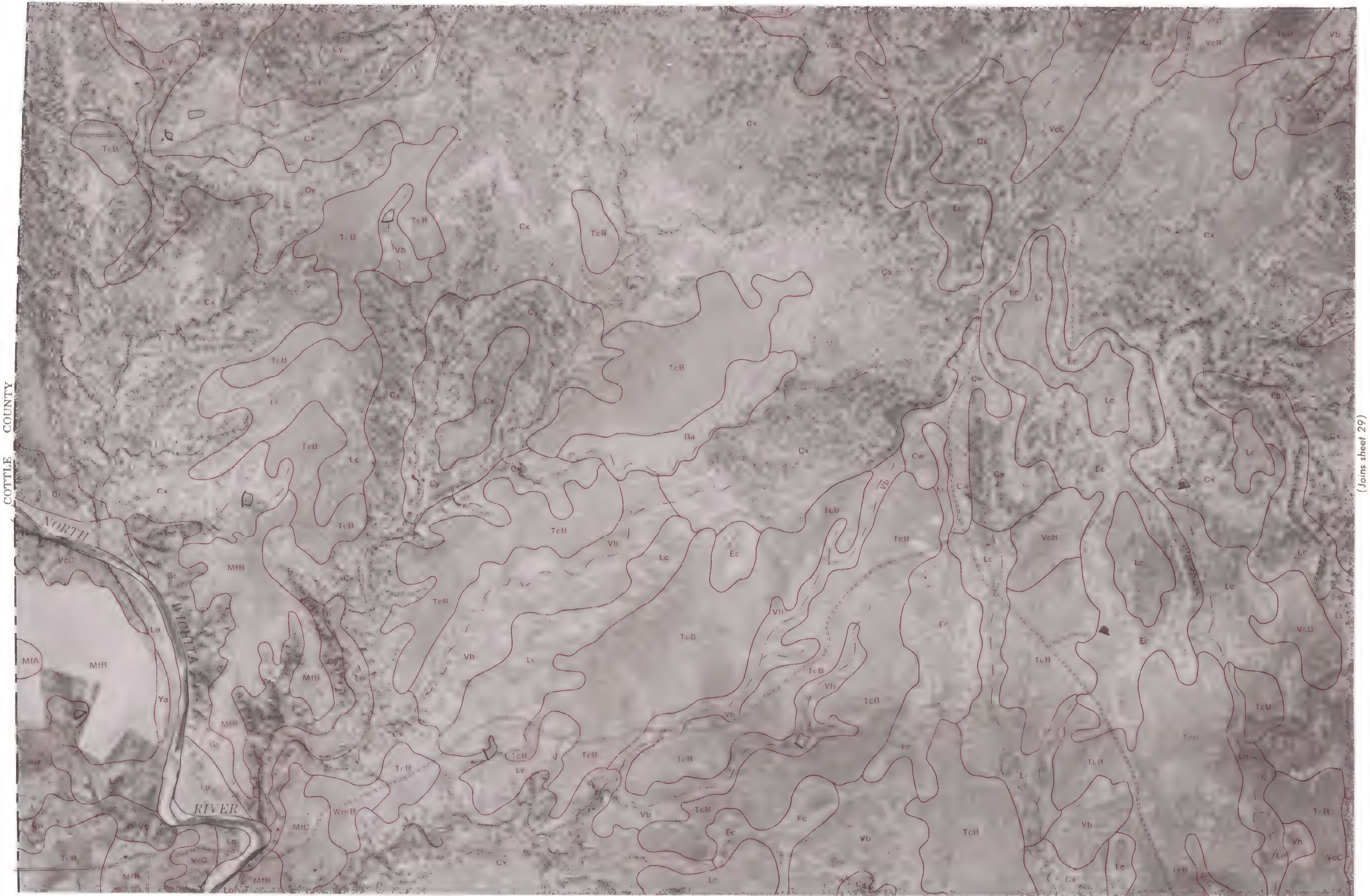
(Joins sheet 20)



28

(Joins sheet 21)

N



(Joins sheet 29)

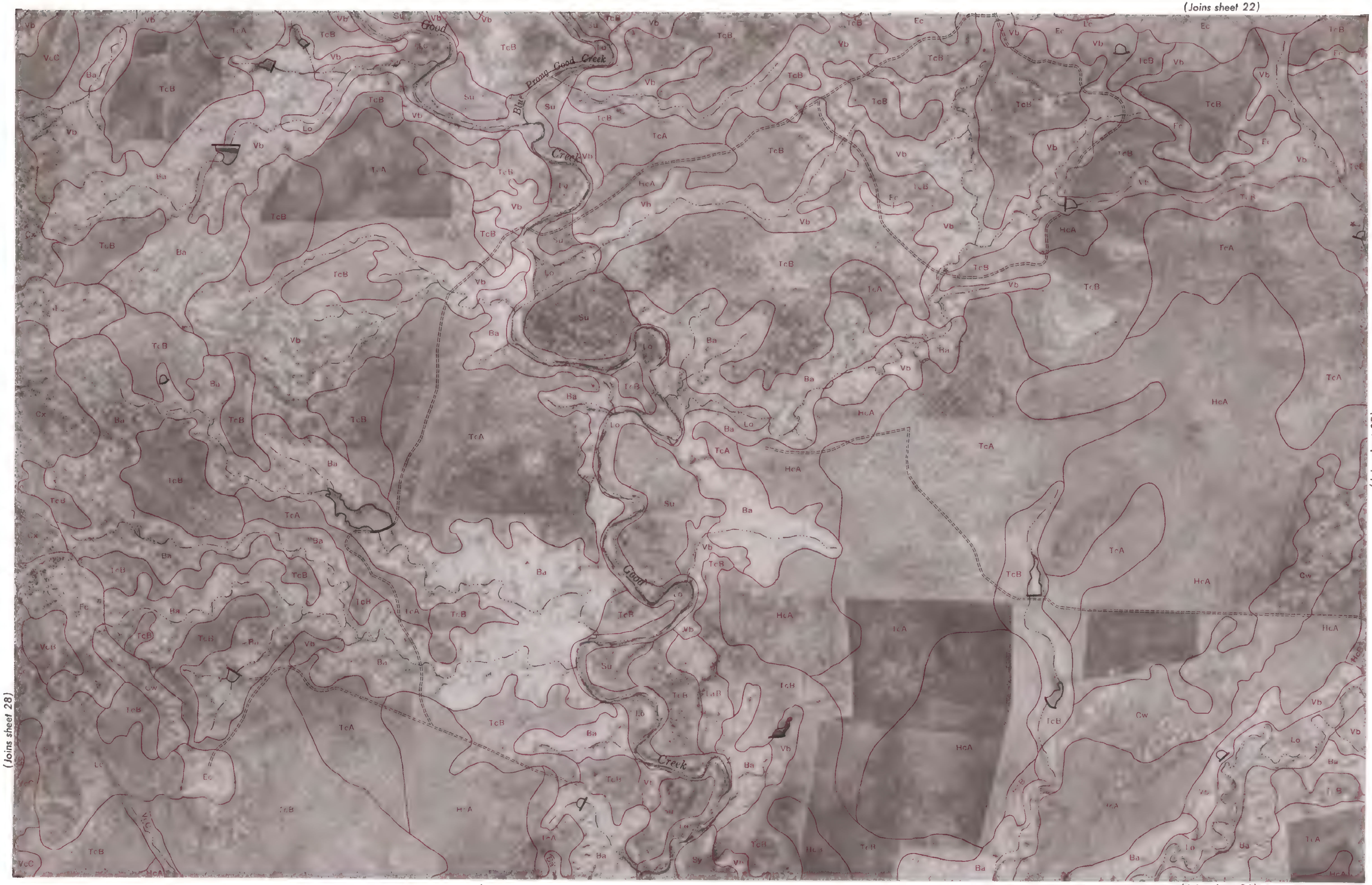
(Joins sheet 35)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

(Joins sheet 22)

29

N

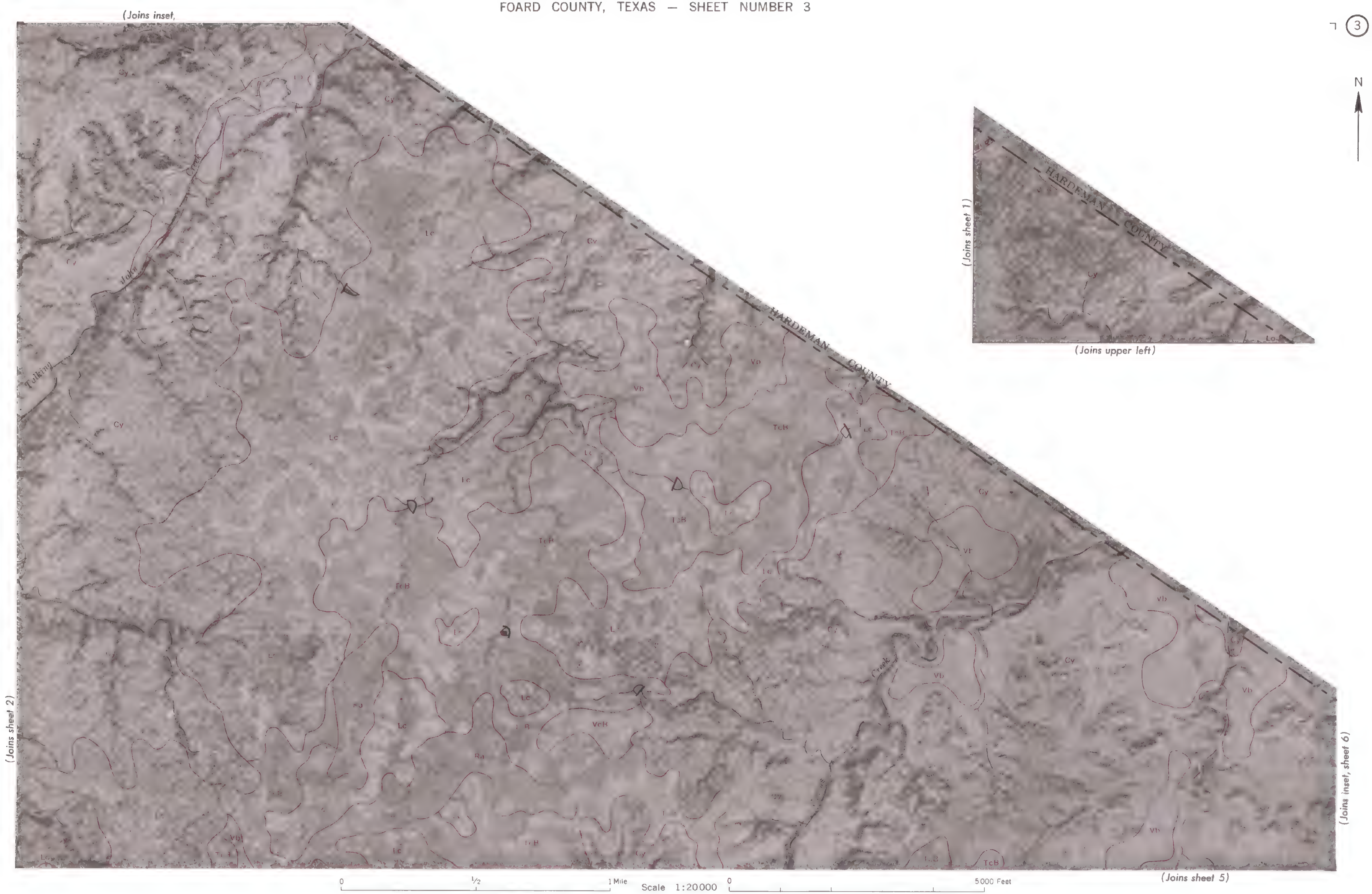


(Joins sheet 28)

(Joins sheet 30)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 36)

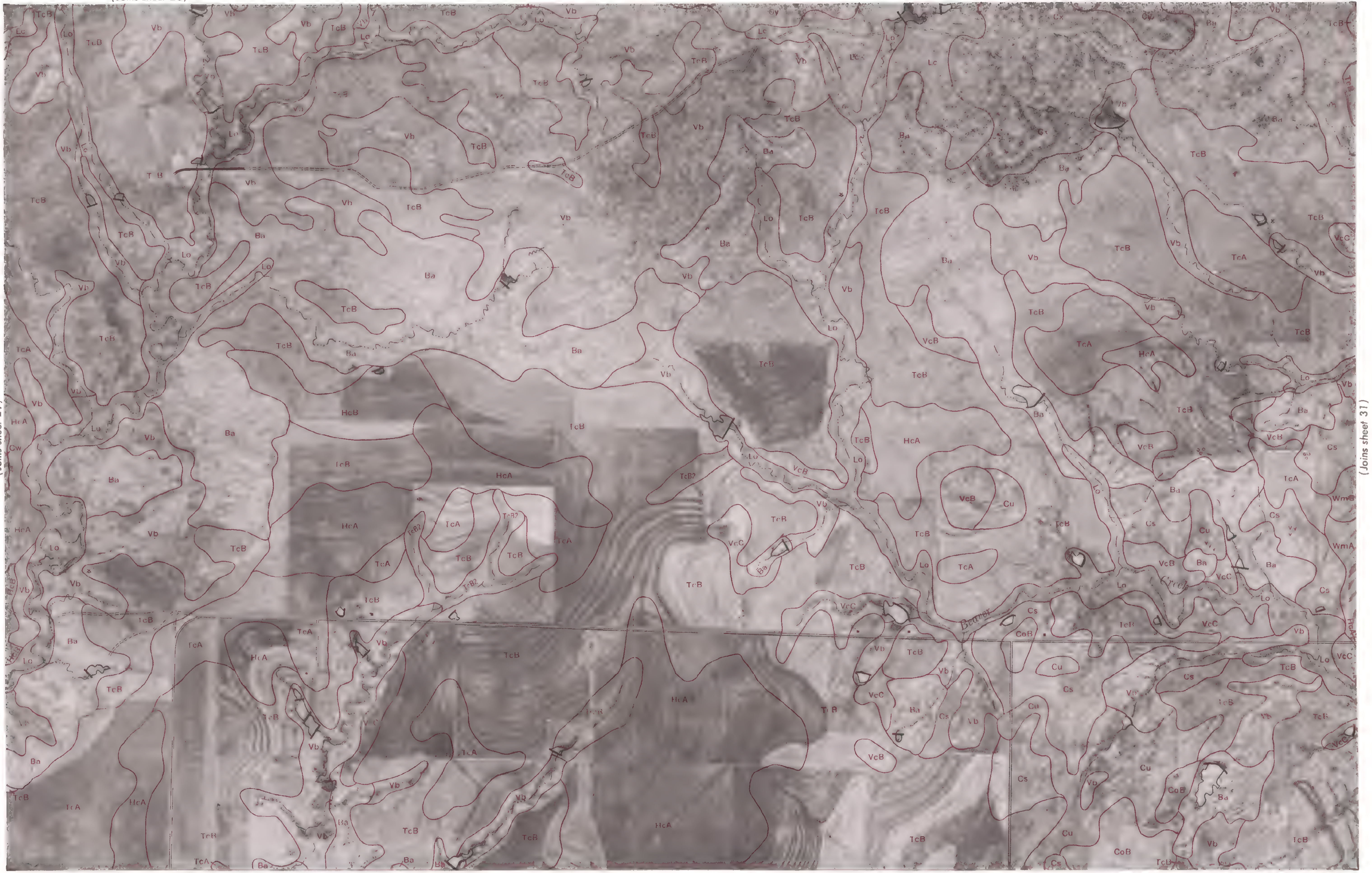

(Joins inset,
N
(Joins sheet 1)
HARDEMAN COUNTY
(Joins upper left)
HARDEMAN COUNTY
John Creek
Talking
Creek
Cy
Lc
Vb
TcB
VcB
Vf
Ra
(Joins sheet 2)
(Joins inset, sheet 6)
(Joins sheet 5)
0
1/2
1 Mile
Scale 1:20000
0
5000 Feet

30

(Joins sheet 23)

N

(Joins sheet 29)



(Joins sheet 31)

(Joins sheet 37)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 24)

31

N

(Joins sheet 30)

(Joins sheet 32)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 38)

(32)

(Joins sheet 25)

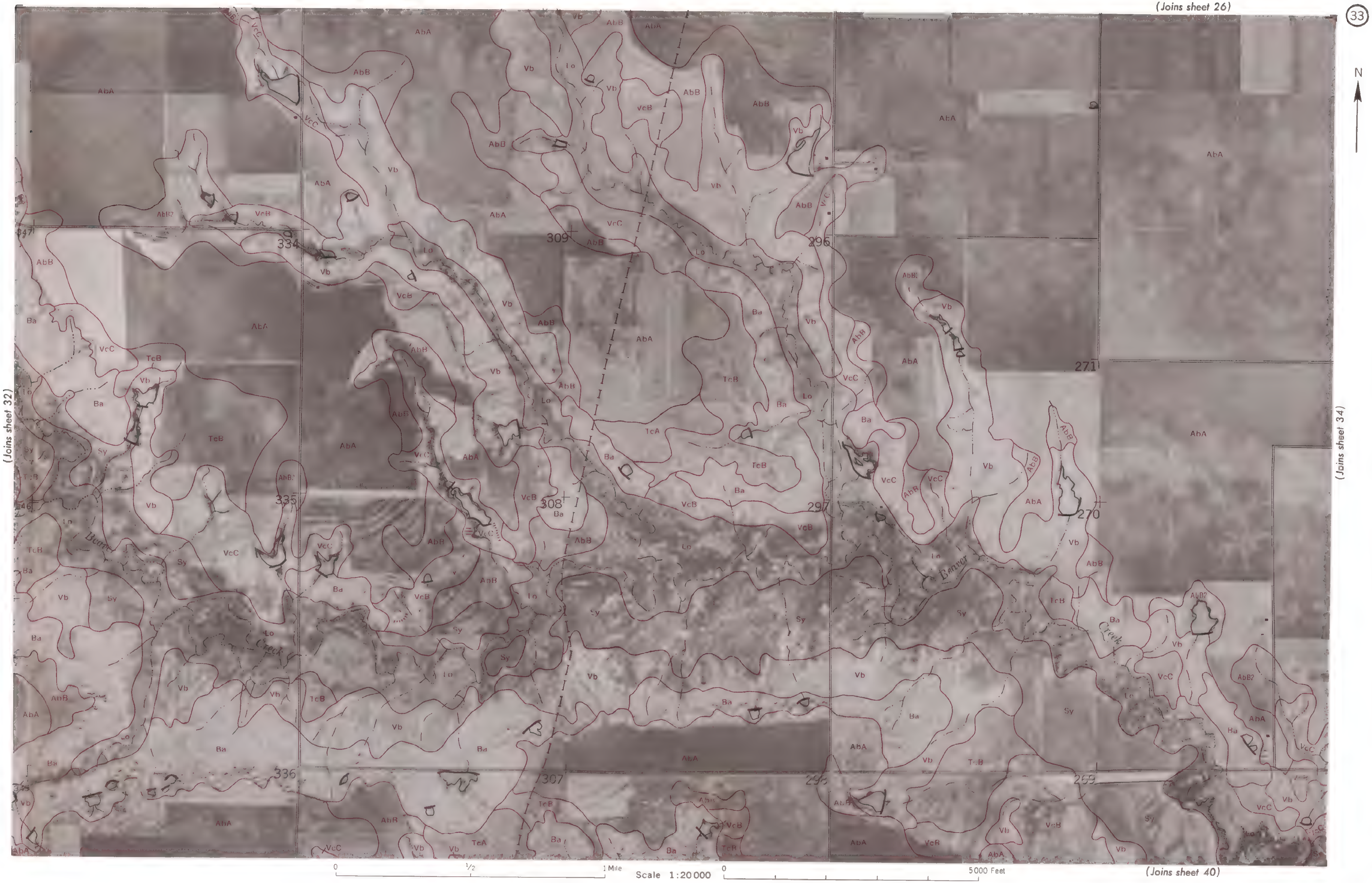
N

(Joins sheet 31)

(Joins sheet 33)

(Joins sheet 39)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet


(Joins sheet 26)
33
N
(Joins sheet 32)
(Joins sheet 34)
Beaver Creek
0
1/2
1 Mile
Scale 1:20000
0
5000 Feet
(Joins sheet 40)

34

N

(Joins sheet 27)

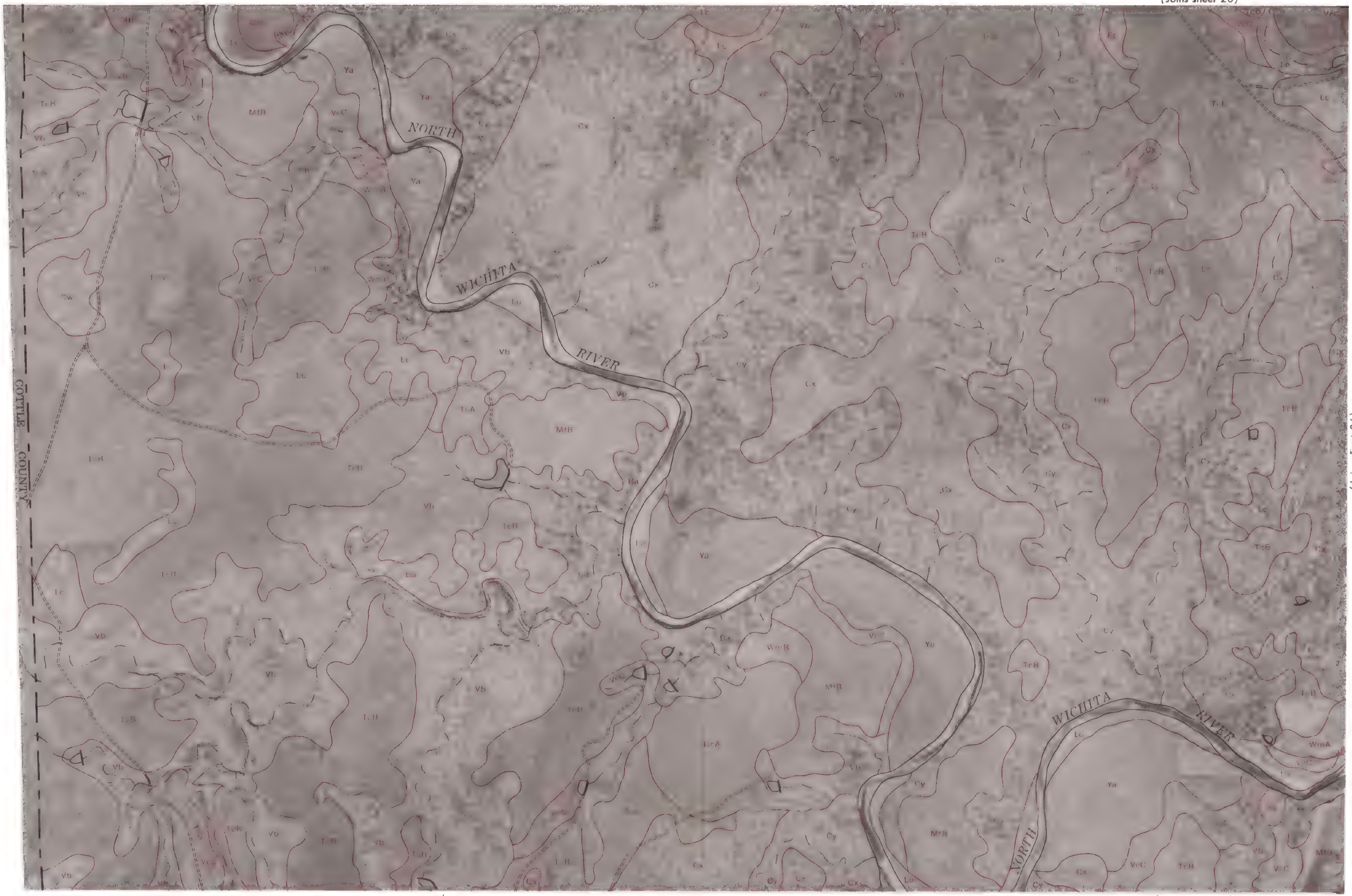
(Joins sheet 33)

(Joins sheet 41)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 28)

N



(Joins sheet 36)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 42)

36

(Joins sheet 29)

N

(Joins sheet 35)

(Joins sheet 37)

(Joins sheet 43)

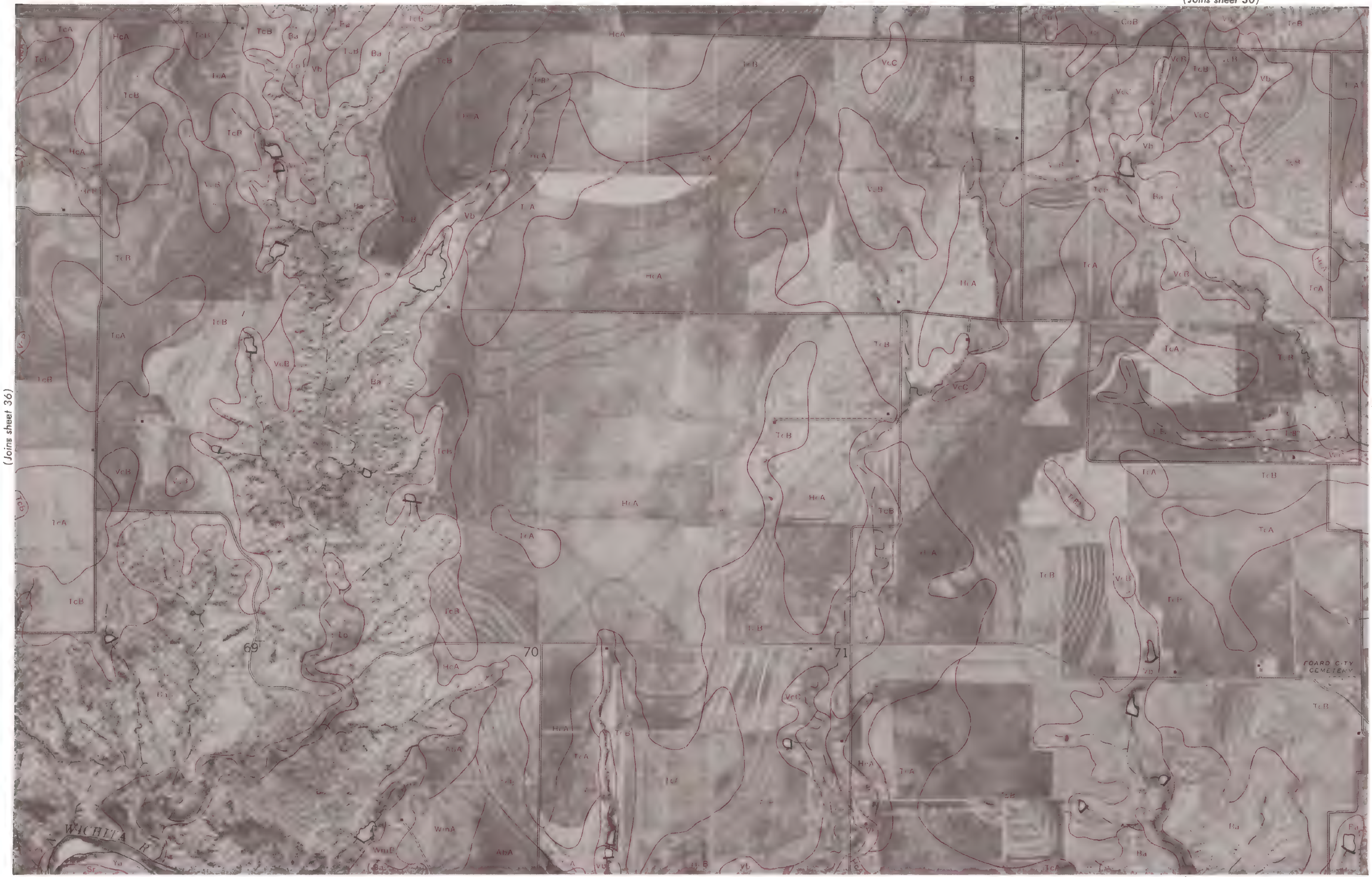
0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 30)

37

N

(Joins sheet 36)



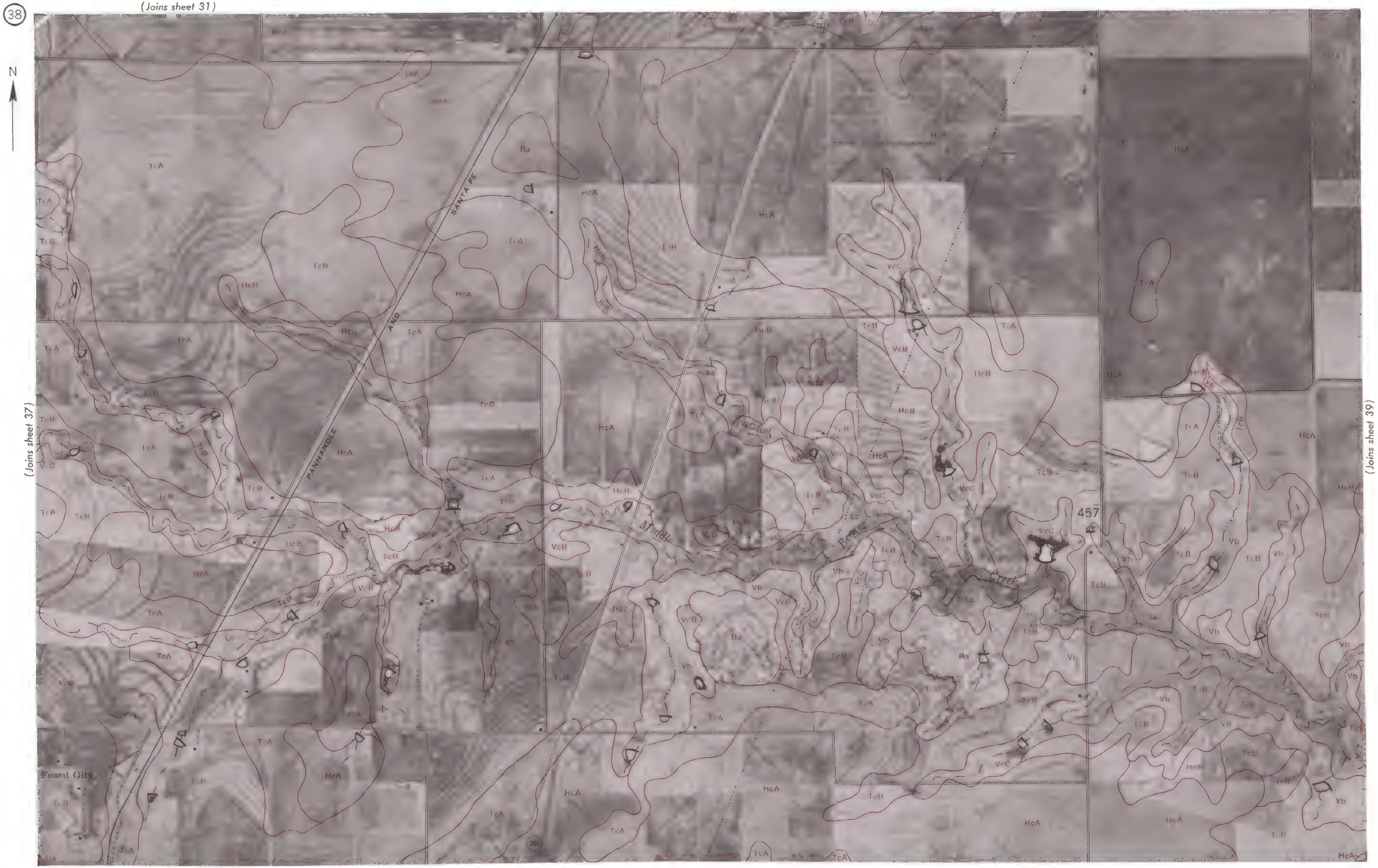
(Joins sheet 38)

(Joins sheet 44)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(38)

(Joins sheet 31)



(Joins sheet 45)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 32)
39
N
(Joins sheet 38)
(Joins sheet 40)
(Joins sheet 46)
AbA
HcA
TcA
TcB
AbB
Vb
VcC
Lo
Beaver
Creek
Middle
0
½
1 Mile
Scale 1:20 000
0
5000 Feet

4

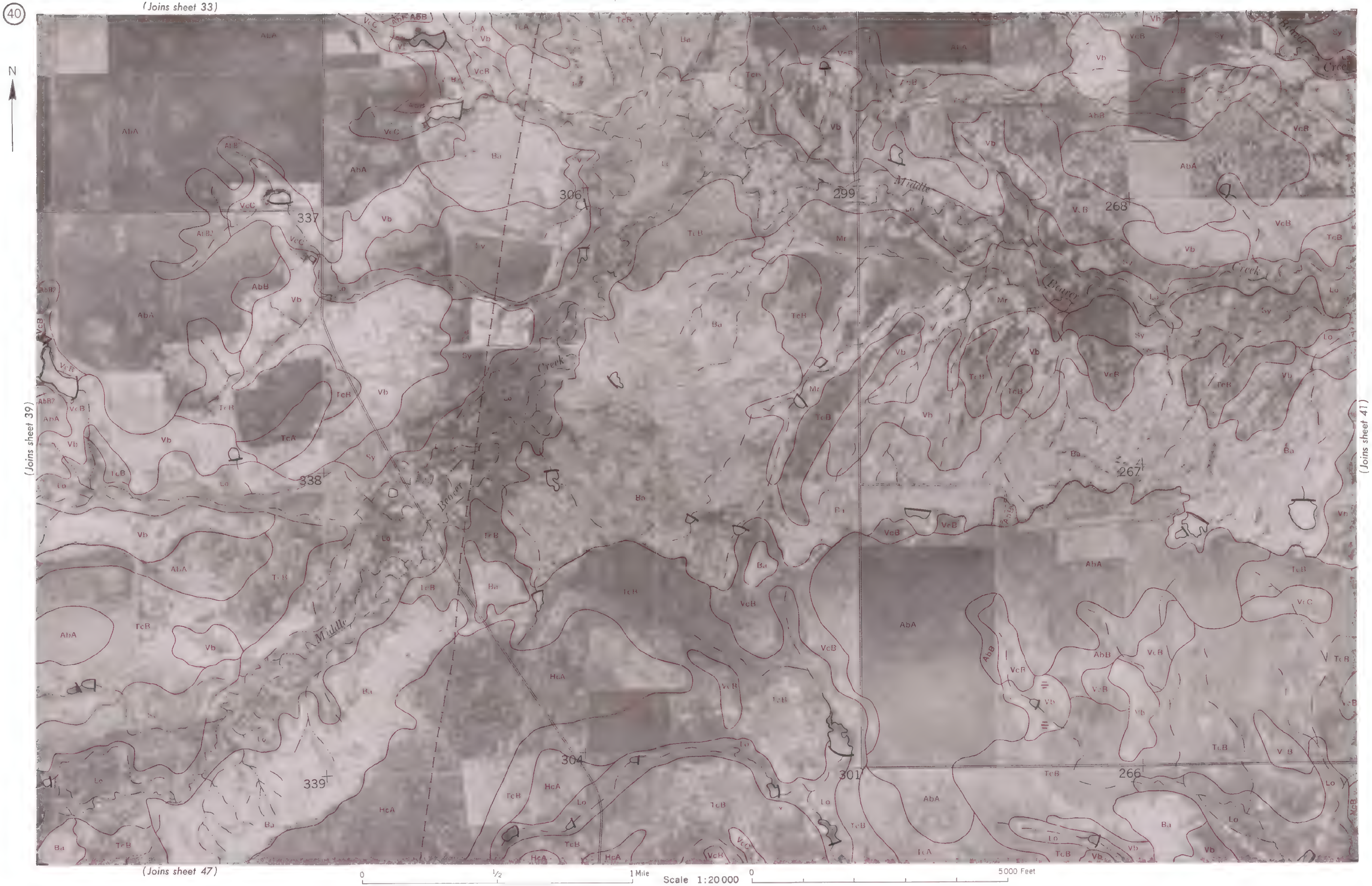
(Joins sheet 2)

N

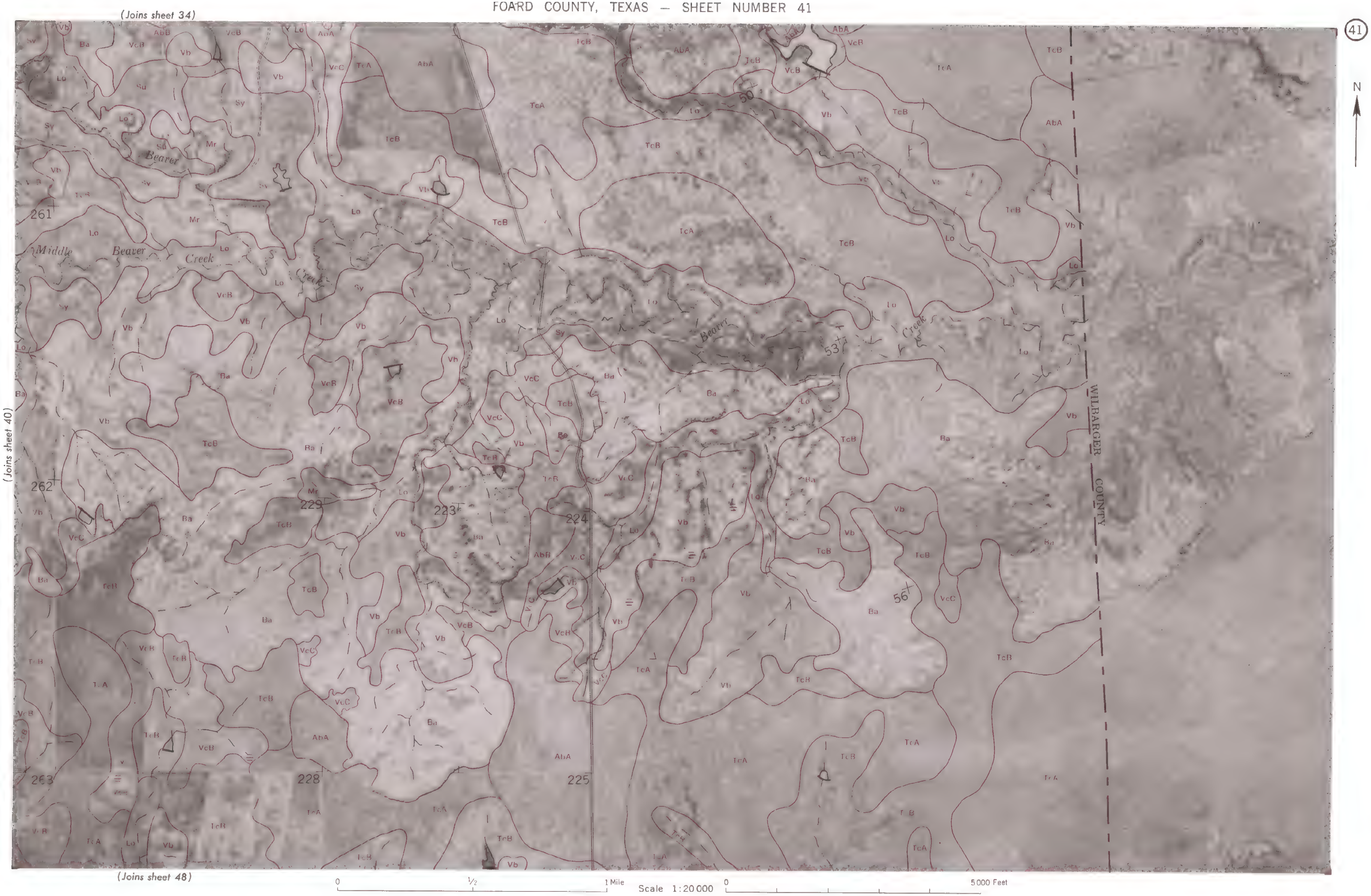
(Joins sheet 5)

(Joins sheet 7)

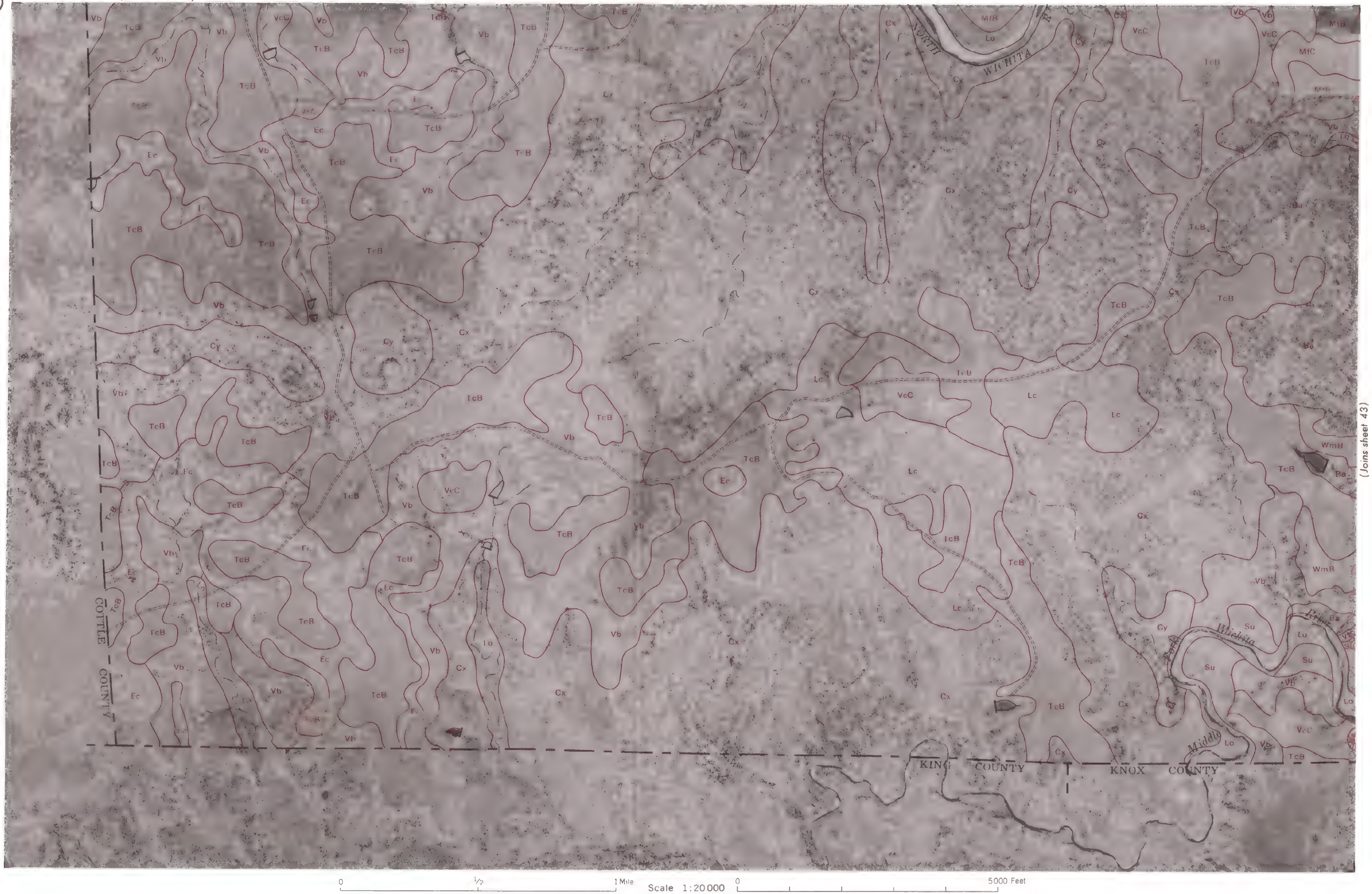
0 ½ 1 Mile Scale 1:20000 0 5000 Feet


40
(Joins sheet 33)
(Joins sheet 39)
(Joins sheet 41)
(Joins sheet 47)
N
Middle
Beaver
Creek
337
338
339
306
304
299
301
268
267
266

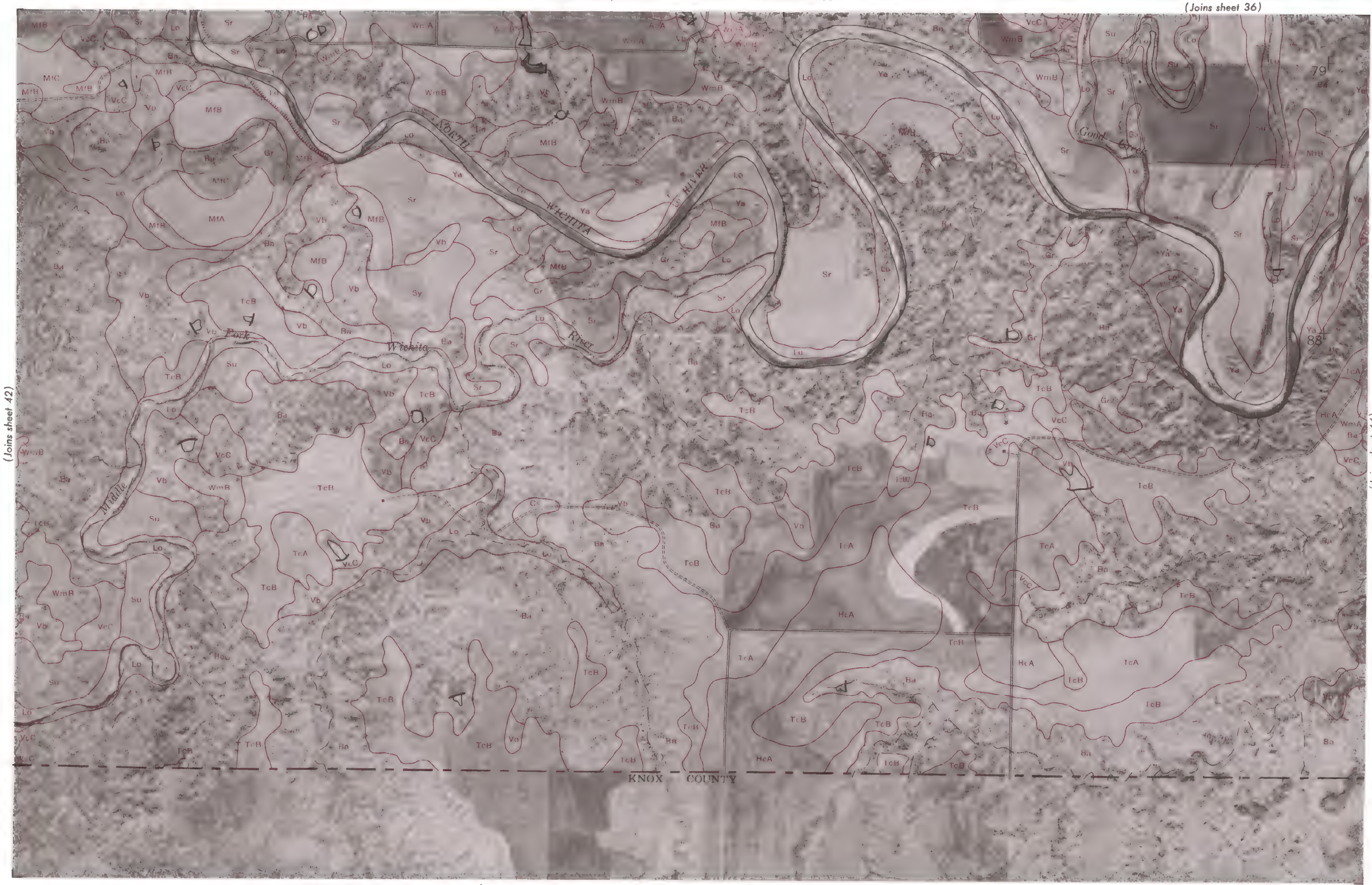
0 1/2 1 Mile
Scale 1:20 000
0 5000 Feet


(Joins sheet 34)
41
N
(Joins sheet 40)
(Joins sheet 48)
Middle Beaver Creek
Beaver Creek
WILBARGER COUNTY
0
1/2
1 Mile
Scale 1:20 000
0
5 000 Feet

FOARD COUNTY, TEXAS — SHEET NUMBER 42



(Joins sheet 36)

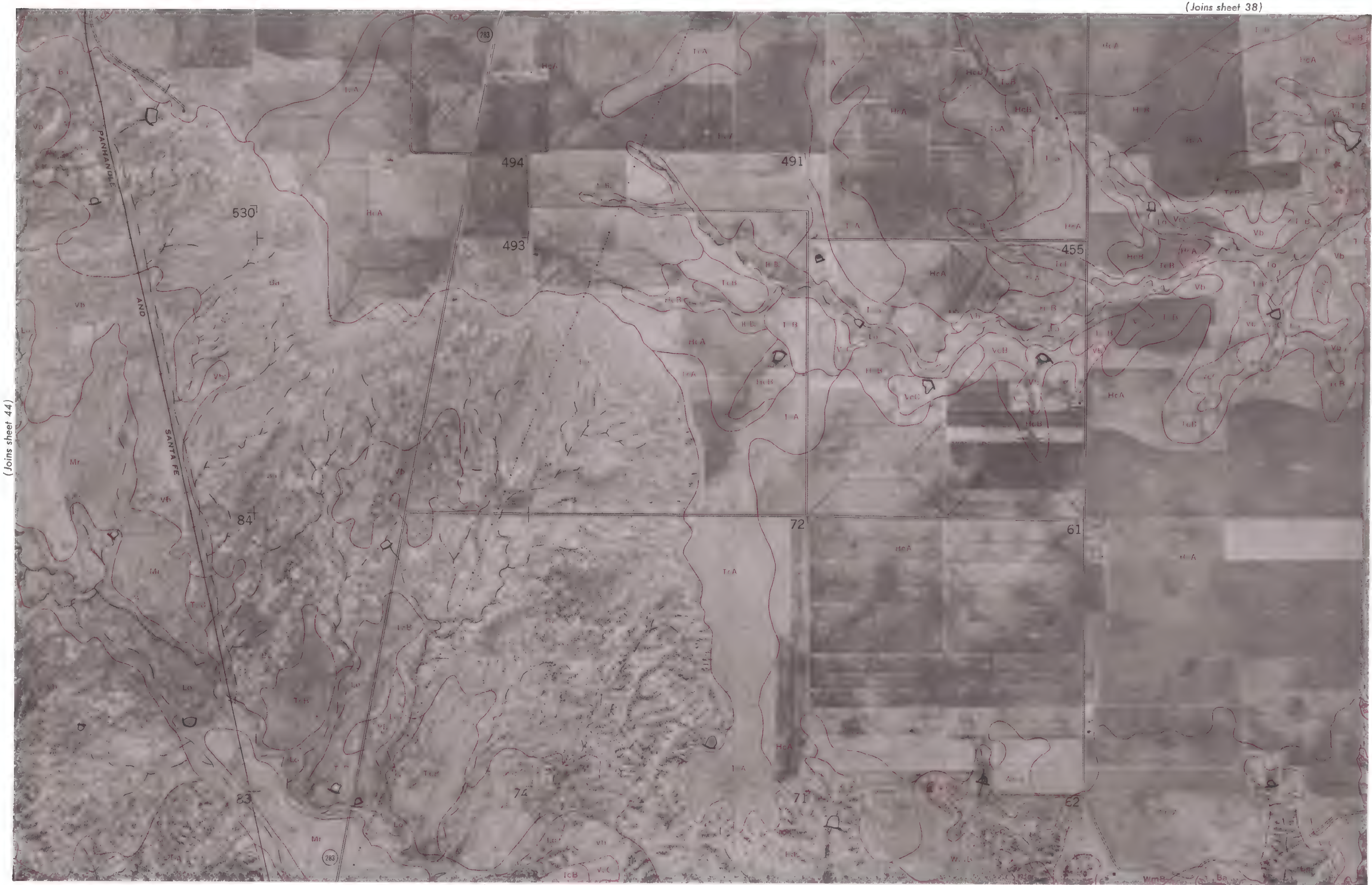


0 ½ 1 Mile Scale 1:20000 0 5000 Feet

44

(Joins sheet 37)

(Joins sheet 38)



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

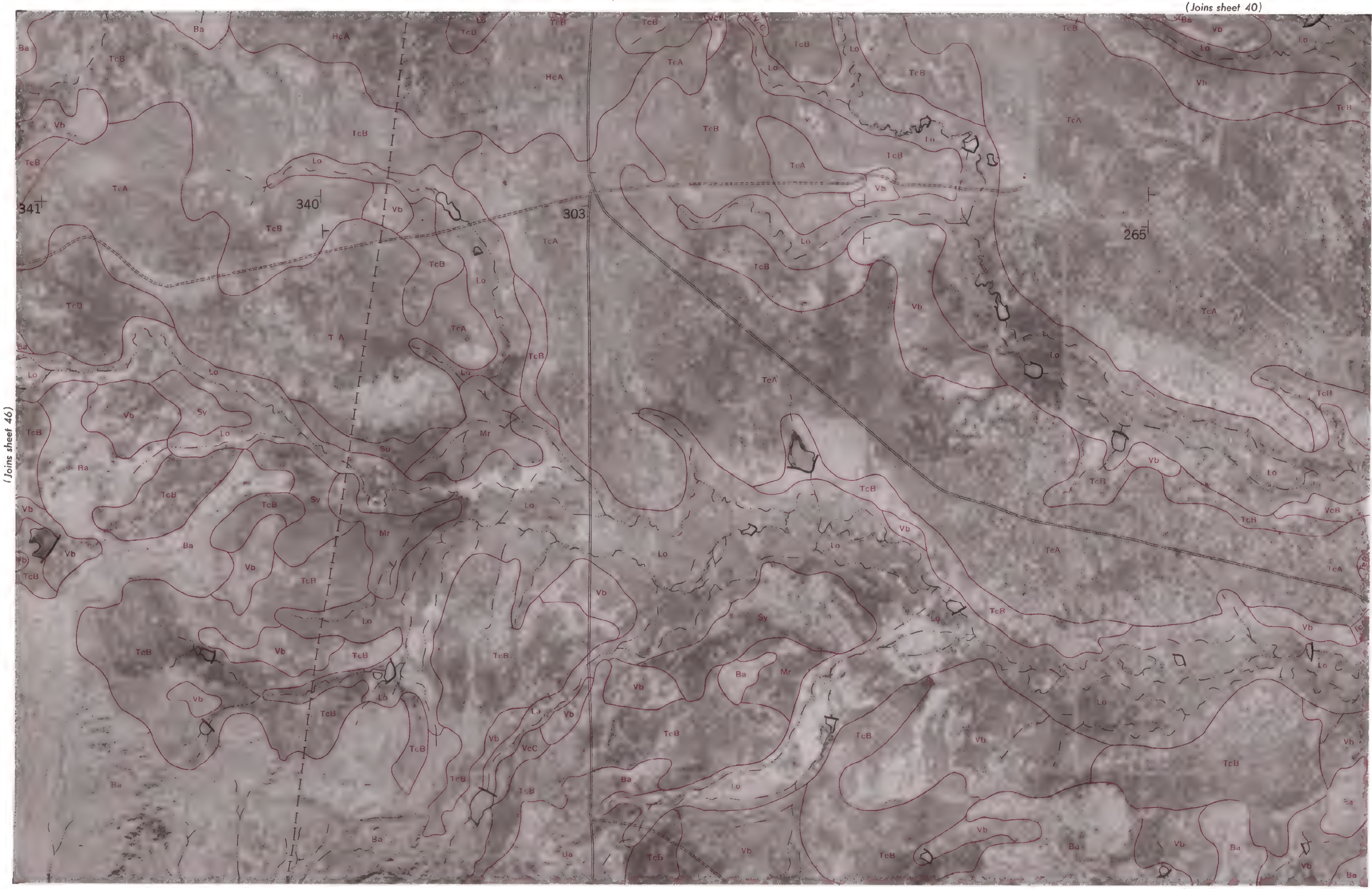
(Joins sheet 49)

46


(Joins sheet 39)
N
(Joins sheet 45)
(Joins sheet 47)
HALSELL RANCH HEADQUARTERS
(Joins sheet 50)
0
1/2
1 Mile
Scale 1:20 000
0
5000 Feet

(Joins sheet 40)

47

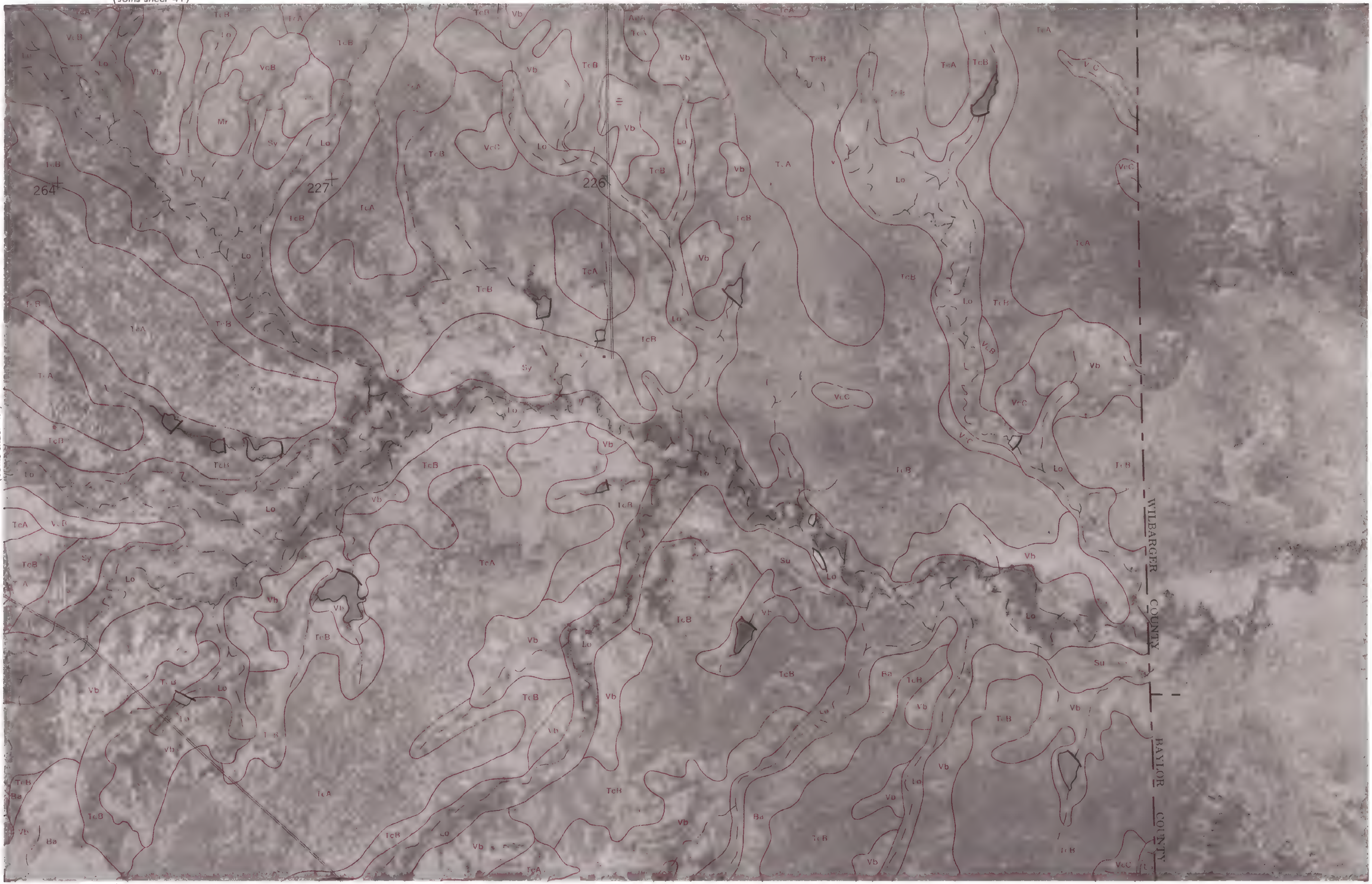


(Joins sheet 51)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

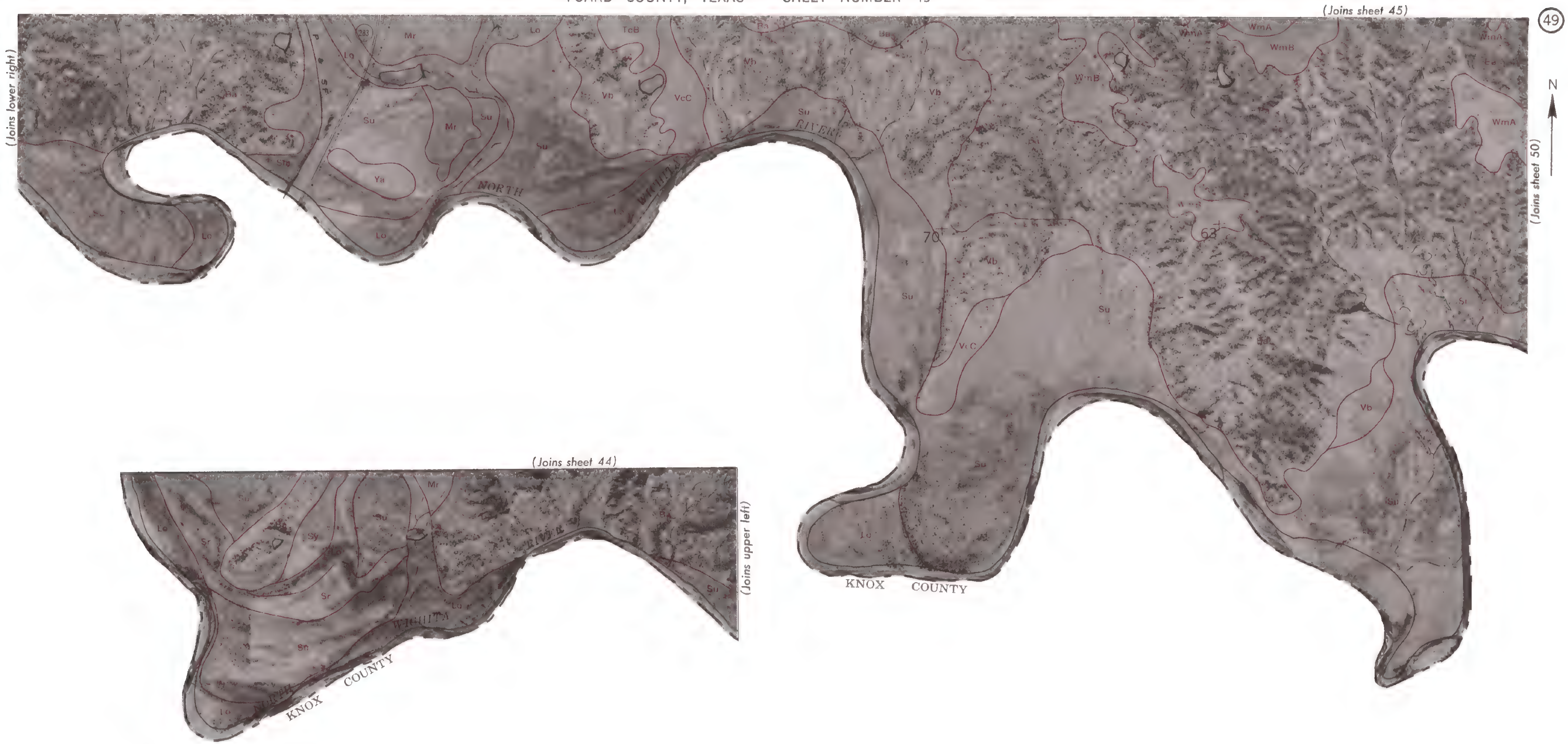
48

(Joins sheet 41)



(Joins sheet 52)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

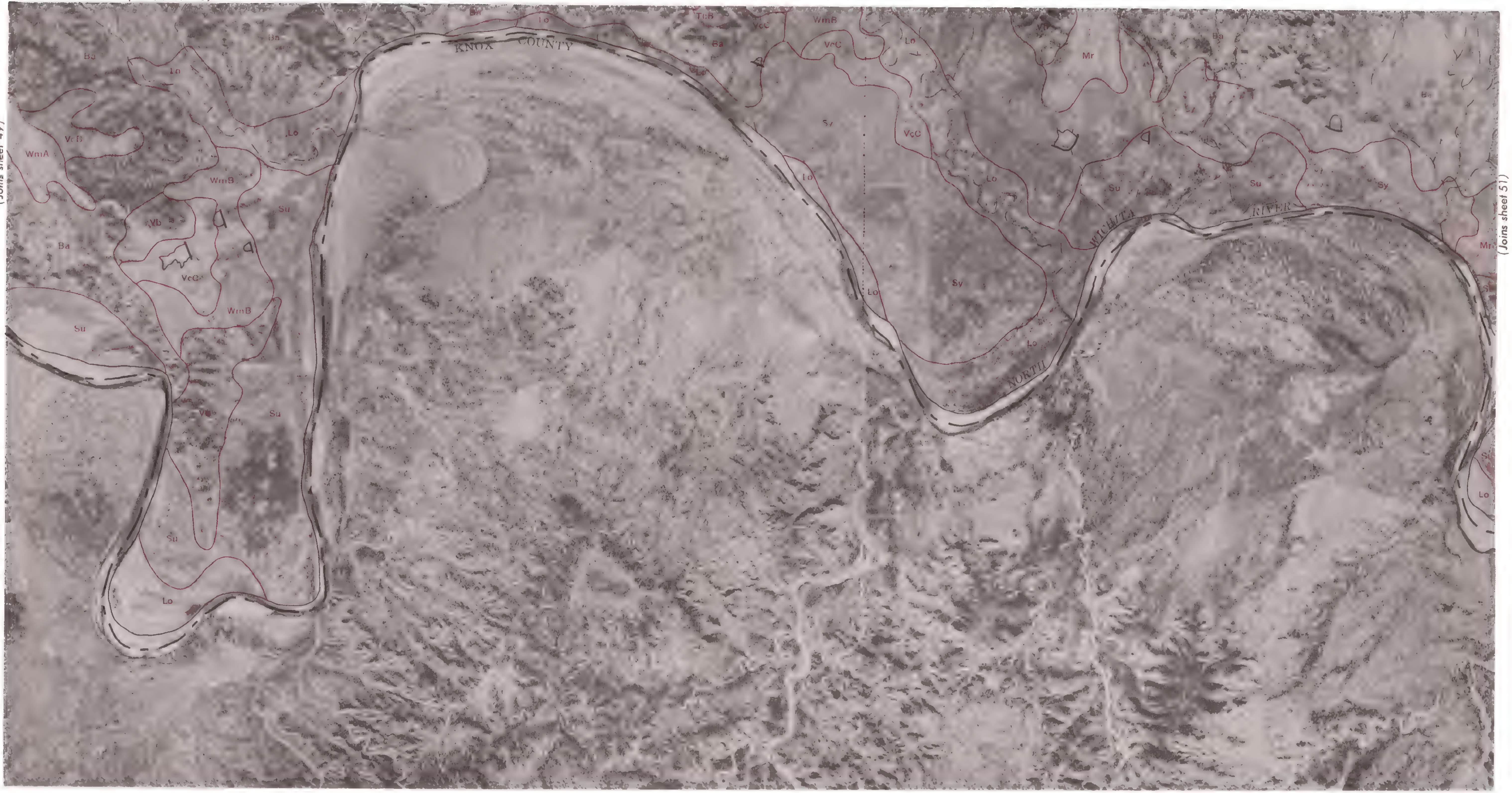


0 ½ 1 Mile Scale 1:20000 0 5000 Feet

0 1/2 1 Mile Scale 1:20000 0 5000 Feet

50

(Joins sheet 46)



0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

(Joins sheet 47)

51

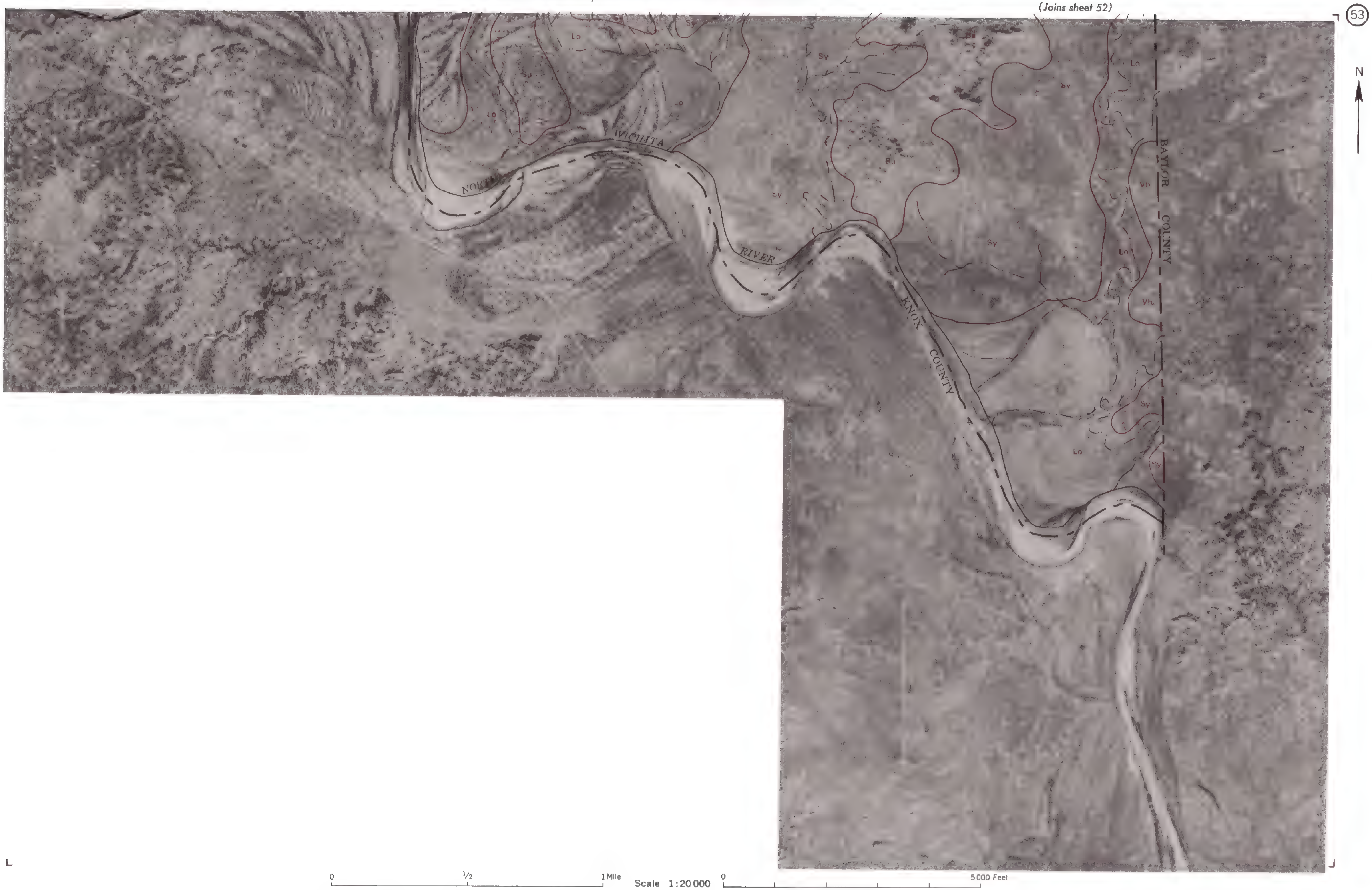
(Joins sheet 48)

N

(Joins sheet 51)

(Joins sheet 53)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet


(Joins sheet 52)
53
N
NORTH
WICHITA
RIVER
KNOX
COUNTY
BAYLOR
COUNTY
Lo
Sy
Vh
0
1/2
1 Mile
Scale 1:20 000
0
5000 Feet

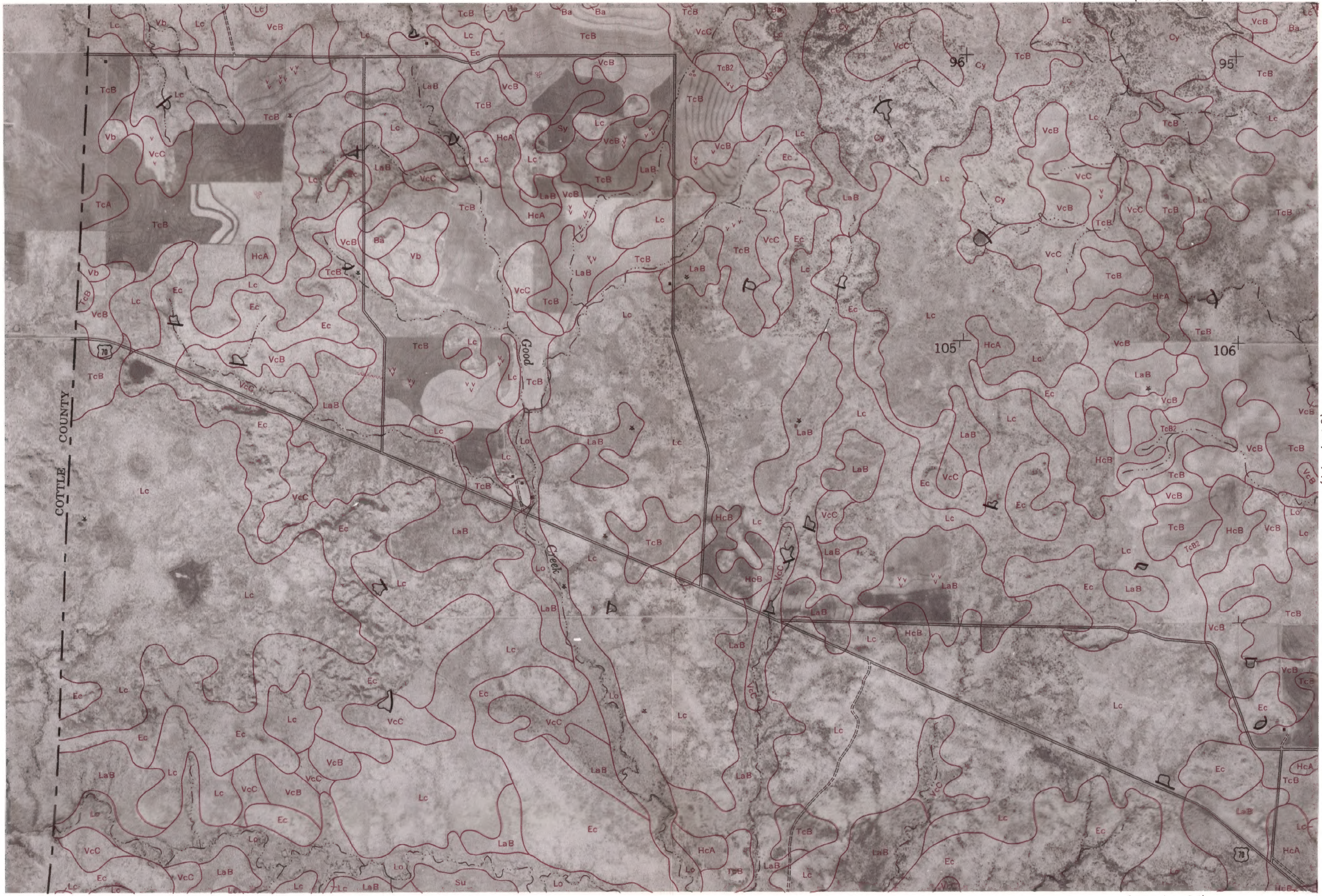
FOARD COUNTY, TEXAS — SHEET NUMBER 6

Scale 1:20000

0 ½ 1 Mile

0 5000 Feet

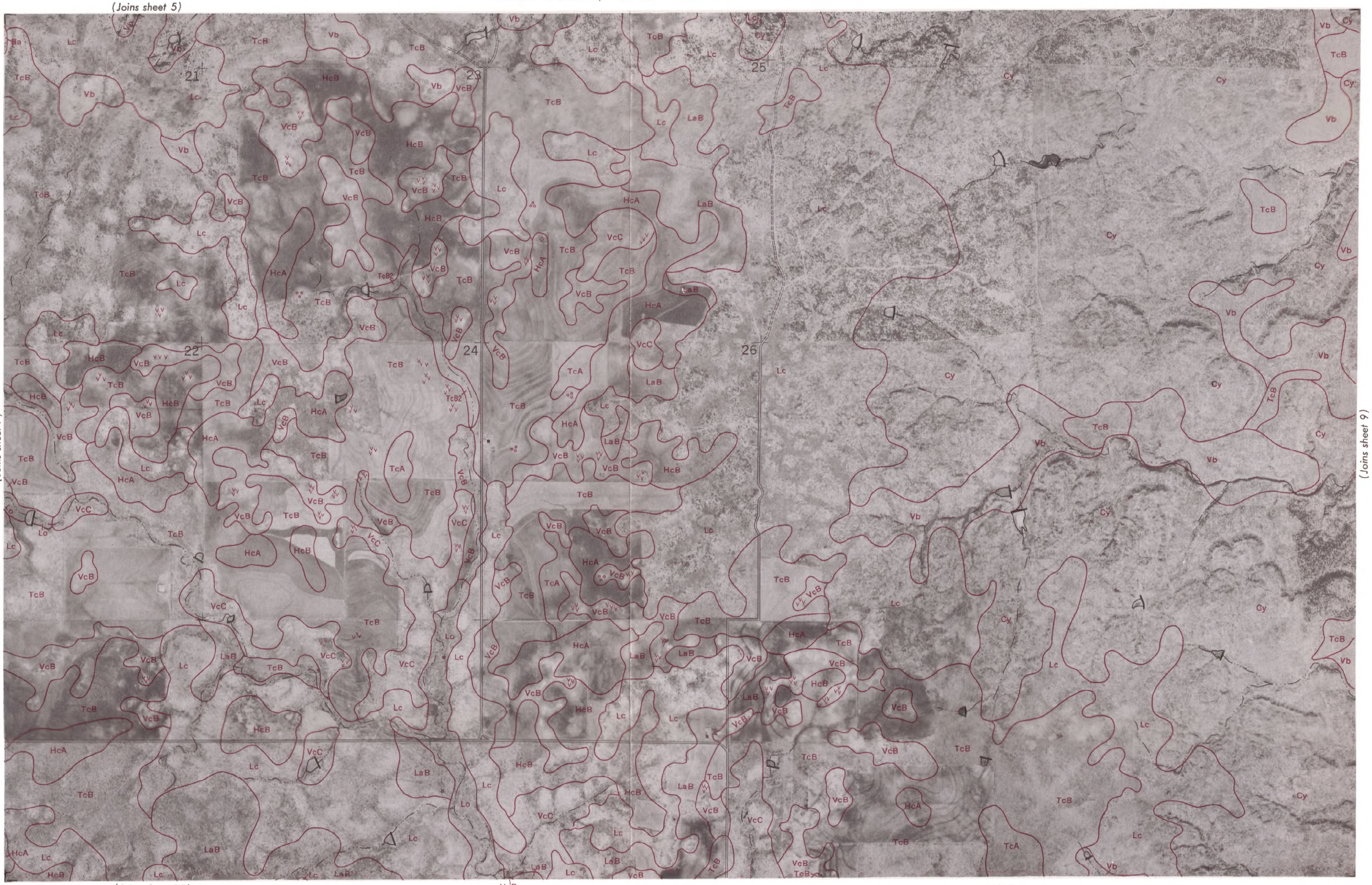
(Joins sheet 4)



(Joins sheet 14)

0 ½ 1 Mile Scale 1:20000 0 5000 Feet

(Joins sheet 5)



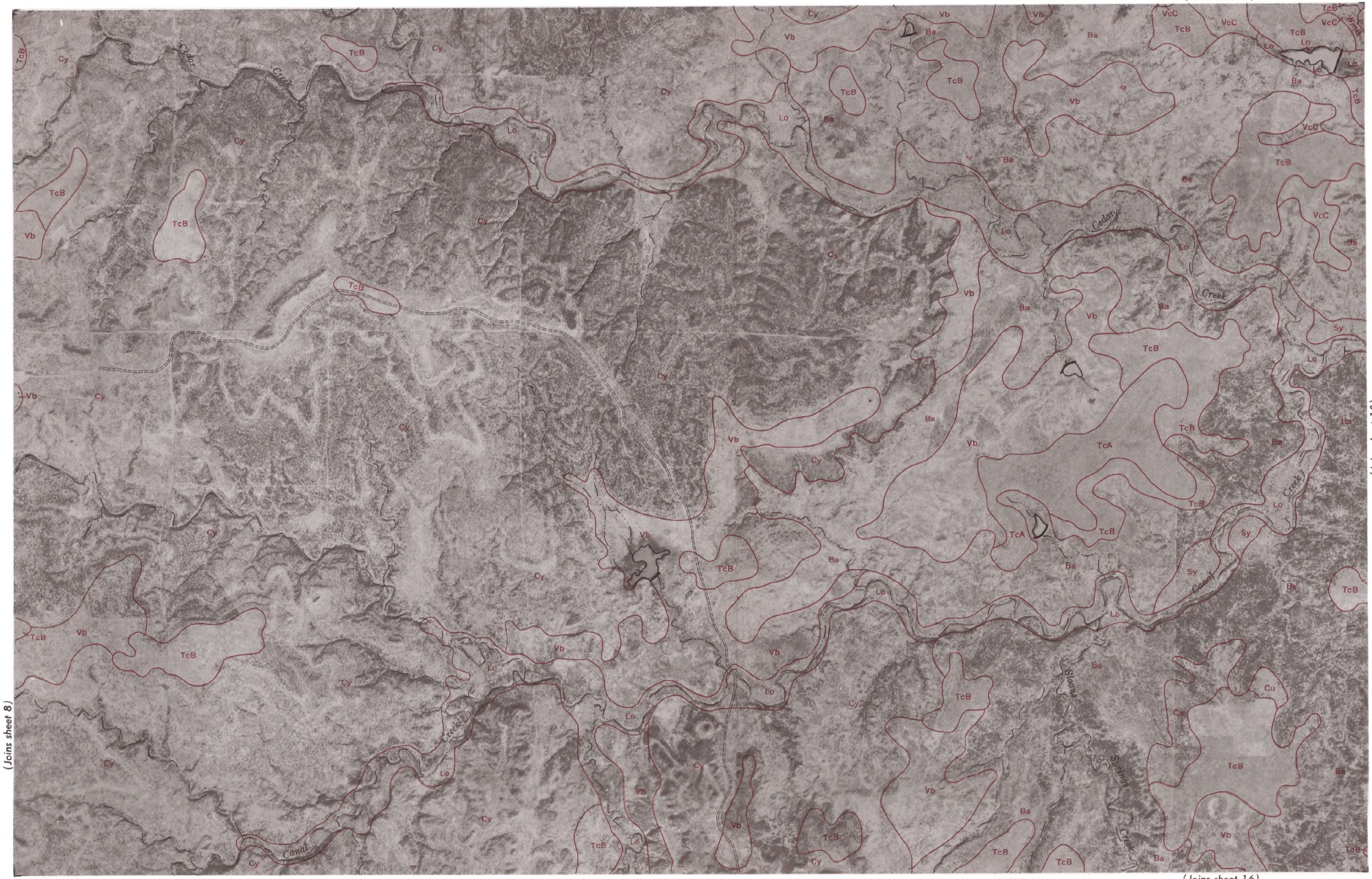
(Joins sheet 15)

0 ½ 1 Mile Scale 1:20 000 0 5000 Feet

FOARD COUNTY, TEXAS — SHEET NUMBER 9

9

(Joins sheet 6)



(Joins sheet 8)

(Joins sheet 10)

(Joins sheet 16)

0 ½ 1 Mile Scale 1:20 000 0 5 000 Feet